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Transmitter identification with a small number of independent observers.

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WITH A SMALL NUMBER OF
INDEPENDENT OBSERVERS

by

Andrew G. Meldrum

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Transmitter Identification with a Small Number of Independent Observers

by

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September 1986

ABSTRACT

This thesis presents and compares algorithms that identify a signal (one or two parameters) from a known group. This identification is done with a small number of observers. Using simulation the algorithms are compared for robustness and accuracy. Robustness is simulated by drawing observations from a Cauchy and also from a mixed normal with two different mixing probabilities. The results of the simulations demonstrate that that the maximum likelihood estimators based on the Cauchy or the mixed normal are satisfactory for both robust and nonrobust (outlier-prone) situations, while classical linear methods perform poorly if outliers are present.

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I. INTRODUCTION

A. THE PROBLEM

In several fields one must identify a true cause from a group of candidates. This identification must often be made with error prone information from a limited number of different observers or sensors. For example, in electronic warfare there may be several sensors which measure a signal from a radar, but exactly which radar type is it? In aviation, a pilot reports a rough running engine to aircraft maintenance. The mechanics use several testers to examine an engine's performance and measure certain parameters. Because of poor calibration and operator error, very different readings result between testers. These errors may lead to "fixing what wasn't broken and not fixing what was".

Let us consider our first fictious example, one occurring in electronic warfare. We are trying to identify a radar by the signal that was received. We can picture a problem in which we have J different radar types that may be in the area. Each of these radars is characterized by several parameters which can be measured and used as identification signatures.

A radar has been detected. The parameters of that radar have been measured by I independent sensors. However, because of calibration errors, time since the last calibration, rough handling, operator error, atmospheric conditions, etc., the measurements do not seem consistent. We know, from historical data, that they tend to have a fair percentage of gross errors, or outliers. We do not know the specific error distribution that best represents an individual sensor at a given time. What is needed is a robust method of identifying the true signal, i.e. one that can tolerate a few gross errors without being misled.

A radar signal, received by observer i on parameter k, could be represented by the true signal θ_k plus the error contributed by observer i namely δ_{k_i}. The equation 1.1 would represent the value recorded by the i^{th} observer on the k^{th} parameter:

$$x_{ki} = \theta_k + \delta_{k_i} \tag{1.1}$$

Figure 1.1 shows a few possible outcomes from a problem with 3 observers and several radars. These samples represent the range of difficulty that might be encountered, from trivial identification to extremely difficult cases. In these examples radar #3 was actually active and the others were silent, but this fact was unknown to the observers.

B. APPROACH

1. Single Parameter Case

If we assume that there is only one parameter available to identify the radars, then there are several Bayesian and Non-Bayesian algorithms that might be employed. We will compare a few of each for accuracy and robustness. We will consider various error distribution assumptions and look at the probability of each algorithm making a correct identification. The higher the probability of correct identification, or hit probability, the greater is the algorithm's accuracy and usefulness.

First, let us examine the single parameter case. Of course, our goal is to use analytical methods when possible. But, for the most part, simulation will be necessary to evaluate the following methods:

Non-Bayesian Algorithms

- average of the observations
- weighted mean
- standard median
- voting algorithm
- biweights
- maximum likelihood method based on mixed normal distribution
- maximum likelihood method based on Student - t distribution

All of the above provide summaries of the I determinations; the particular summary is then compared to each possible parameter (assumed known), and the nearest neighbor is identified.

Bayesian Algorithms

- based on normal distribution assumption
- based on mixed normal distribution
- based on Student-t distribution

Each methods Bayesian posterior is computed for each parameter value, and the maximum posterior value is used to identify the active individual.

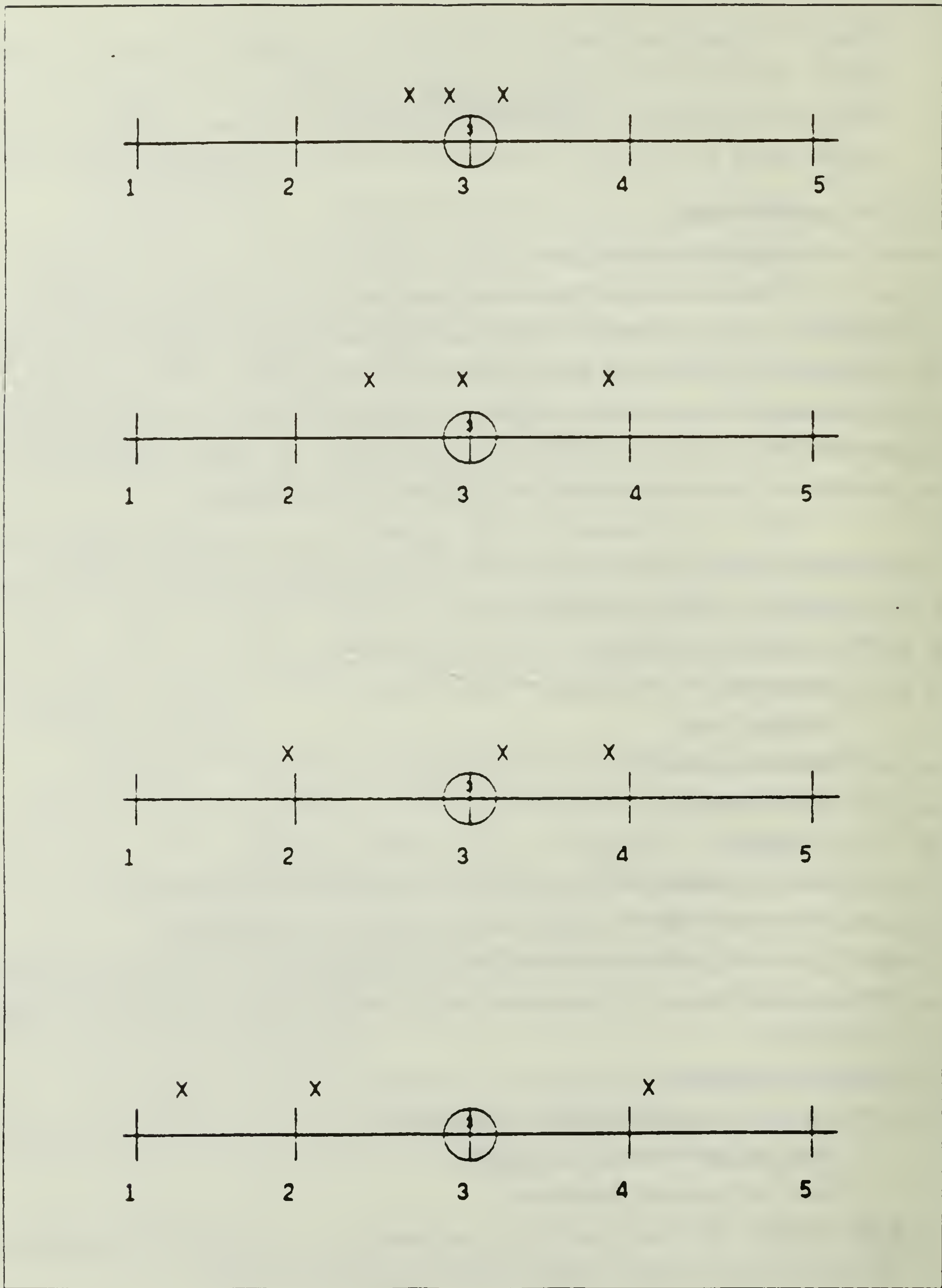

Figure 1.1 Possible Observations on a Signal.

If the assumed a priori probabilities are correct, then one would expect the Bayesian methods to supply better results. But, as the a priori probabilities become less and less accurate these methods would be expected to be misled and become less effective.

In order to test the properties of the methods under consideration the error term will be generated using different distribution families. These error distributions will include:

- normal
- mixed normal with epsilons (mixing probabilities) equal to 0.1 and 0.25
- Student-t with 1 degrees of freedom (i.e., a Cauchy)

These different distributions have the affect of varying the weight and shape of the tail; the heavier the tails, the more outliers there are. The distributions and parameters used will be discussed more throughly in Chapter 2.

Through simulations we want to examine the effects of the different error distributions on the identification methods. Also, we need to take a look at the sensitivity of the each technique to changes in the following:

- scale (standard deviation for the normal model)
- epsilon for the mixed normal based error model (the probability of an outlier, roughly speaking)
- prior probabilities for the Bayesian methods
- number of observers (2 to 5)

2. **Bivariate Parameter Case**

A more realistic case to be considered is one in which there are two parameters, each of which can be measured and used to identify the radar. The measurement of these parameters will again be subjected to observation errors, but these errors may also be correlated. That is, the platform making the measurements may induce some error that is common to both parameters and some error that is not. We will use the standard correlation coefficient (ρ_i) to represent this interaction.

We will examine the following four non-Bayesian algorithms for their robustness to outliers, changes in correlation, and scale interactions.

- median
- bivariate normal maximum likelihood estimator
- bivariate mixed normal maximum likelihood estimator
- bivariate Student t maximum likelihood estimator

Each of the above estimators will be evaluated using a mixed normal error distribution and a bivariate Student t, as in the one parameter case. These, as in the one parameter case, simulate a variety of conditions that we want to examine.

II. ERROR MODELS AND DATA GENERATION

A. SINGLE PARAMETER CASE

1. Model

A radar emits a one parameter signal that is received and measured by I sensors. The I measurements of that signal are sent to a central processing point in order to identify the radar. Each measurement is an unbiased estimate of the true signal, which takes on one of J known values(μ_1, μ_2, ..., μ_J).

In order to simplify the analysis we have postponed treating the more realistic case of randomly spaced true signals and have concentrated on equally spaced μ_j. Then, without loss of generality, we can assume that the radar signals are all 1 unit apart. Note that the computer code in Appendix B and C will handle the more general cases. For the Non-Bayesian algorithms the assumption that the signals are 1 unit apart creates a simple acceptance window or nearest neighbor decision rule. If the estimator of the signal (θ) is within 0.5 of the true value, then a correct identification will be made.

Though in actuality each sensor would have a distribution which models it the best, we have assumed that all the sensors have the same error distribution. This assumption allows for more direct comparisons between methods. This is not a constraint that is imposed by the computer code. The code in Appendix B permits different distributions for each observer.

Another simplifying assumption was that the radar putting out the signals has no inherent variation. This is obviously not true but was reserved for later study.

2. Data Generation

Three families of distributions were used to simulate the error term in the measurements of a sensor. We will discuss each distribution in the following paragraphs. We will examine why these distribution were chosen and why the particular scale parameters were used.

a. Normally Distributed Error

The first distribution considered is the normal, with variances ranging from 0.09 to 0.49. The normal distribution provides a strong base case for which to compare the estimators. It is very well understood, and in some cases the algorithm hit

probabilities can be calculated or approximated without simulation, thus providing a means to verify our simulation procedures.

The spread of variances from 0.09 to 0.49, when combined with our previous assumption that the radar signals are all equally spaced at 1 unit apart, covers a wide range of difficulties. For example, a variance of 0.25 puts 68.4 percent of the single observations within our mentioned plus or minus 0.5 identification window. We would expect fairly accurate results.

The computer simulation used the IMSL routine GGNML to generate the normal random numbers. The random numbers are all generated in subroutine DRAW.

b. Mixed Normal Distributed Error

The mixed normal combines two normal distributions. The first has the same scale (standard deviation) as the previous normal; the second has a scale that is ten times as large. The second normal is chosen with probability ε_i and the first with probability $1-\varepsilon_i$. The effect is that we induce a certain percentage of wide outliers. This is another way of simulating heavy tails. Equation 2.1 from Mood, Graybill, and Boes [Ref. 1:p. 122] was used to compute the mixed normal error model.

$$f_i(x_i/\theta) = (1-\epsilon_i)\frac{1}{\sqrt{2\pi}\,\sigma_{i1}}\,e^{-\frac{1}{2}\left[\frac{x_i-\theta}{\sigma_{i1}}\right]^2} + \epsilon_i\frac{1}{\sqrt{2\pi}\,\sigma_{i2}}\,e^{-\frac{1}{2}\left[\frac{x_i-\theta}{\sigma_{i2}}\right]^2} \qquad (2.1)$$

where: ε_i = contamination factor

σ_{i1} = scale of the first term

σ_{i2} = scale of the second term

Here the first scale parameter covered the same range as in the normal, but the second scale was 10 times the first. If the error contribution came from the second term of the mixed normal, then it is easy to see that a selection from a normal with a standard deviation of 5 could result in a high probability of observations exceeding the range of our perceived signal values. Further, ε_i ranged from 0.1 to 0.25. This gives a wide range for the number of outliers one might expect: up to 25 percent.

Again, the simulation used the IMSL routine GGNML to generate the normal random variables. GGUBFS was used to generate uniform random variable to pick whether the large scale or small scale parameter would be used to compute the observations.

c. Student-t Distributed Error

The Student-t, in equation 2.2, was included to incorporate heavier tails than the normal. In this context the degrees of freedom were used as a method of adjusting the weight in the tails and σ_i the spread.

$$f_i(x_i/\theta) = \frac{c(d_i)}{\left[1 - \left[\frac{x_i-\theta}{\sigma_i}\right]^2 \frac{1}{d_i}\right]^{(d_i+1)/2}} \tag{2.2}$$

where d_i = degrees of freedom

σ_i = scale parameter

Values for the scale parameter were the same as in the normal case. It is important to remember that the (scale parameter)^2 is not the variance. The variance is given by:

$$VAR(x_i) = \{d_i/(d_i-2)\}\sigma_i^2 \qquad \text{for } d_i > 2 \tag{2.3}$$

Note; this equation does not apply for degrees of freedom 2 or less. The Cauchy, which was used as one of our error sources, is a t with degrees of freedom equal to 1 and has an undefined "infinite" variance. See Barr and Zehna A Cauchy has notoriously heavy tails and should pose a difficult test for the algorithms.

The computer model in subroutine DRAW of Appendix B uses the IMSL routine GGAMR to generate the pseudo random numbers.

B. BIVARIATE PARAMETER CASE

1. The Model

A radar again emits a signal. This signal contains two parameters which are measured. Each estimate of a parameter has some variance $\sigma^2_{x_i}$ or $\sigma^2_{y_i}$ associated with it; where the index i refers to the i^{th} observer. There is also some covariance that relates the interaction between the two estimates. We will use the classical correlation coefficient to represent this interaction.

There are two descriptions of the placement of the pairs that describe a radar. These are shown in figure 2.1

We will maintain only one error distribution for all observers, not because we believe this to be the case, but because it makes comparison easier.

2. Data Generation

a. Bivariate Normal Error and Mixed Normal Error

The bivariate mixed normal distribution, given in equation 2.4, will be used as one representation of the errors.

$$f_i(x_i, y_i/\underline{\theta}) = (1-\epsilon_i)\frac{1}{2\pi\sigma_{1x_i}\sigma_{1y_i}(1-\rho_1^2)} \tag{2.4}$$

$$\cdot\exp -\left\{\frac{1}{2(1-\rho_1^2)}\left[\left[\frac{x_i-\theta_x}{\sigma_{1x_i}}\right]^2 - 2\rho_1\left[\frac{x_i-\theta_x}{\sigma_{1y_i}}\right]\left[\frac{y_i-\theta_y}{\sigma_{1y_i}}\right] - \left[\frac{y_i-\theta_y}{\sigma_{1y_i}}\right]^2\right]\right\}$$

$$+\ \epsilon_i\frac{1}{2\pi\sigma_{2x_i}\sigma_{2y_i}(1-\rho_2^2)}$$

$$\cdot\exp -\left\{\frac{1}{2(1-\rho_2^2)}\left[\left[\frac{x_i-\theta_x}{\sigma_{2x_i}}\right]^2 - 2\rho_2\left[\frac{x_i-\theta_x}{\sigma_{2x_i}}\right]\left[\frac{y_i-\theta_y}{\sigma_{2y_i}}\right] + \left[\frac{y_i-\theta_y}{\sigma_{2y_i}}\right]^2\right]\right\}$$

The equation 2.5 from Law and Kelton [Ref. 3:p. 269] was used to simulate the observations.

$$x_i \sim N(\theta_x, \sigma_{x_i}^2) \tag{2.5}$$

$$y_i \sim \theta_y + \rho_1\frac{\sigma_{y_i}}{\sigma_{x_i}}(x_i-\theta_x) + N[0, \sigma_{y_i}^2(1-\rho_2^2)]$$

where: σ_{x_i} and σ_{y_i} are the scales associated with the first or second terms

The values for epsilon range from 0 (bivariate normal) to 0.25. The ρ_{1i} (correlation coefficient for the first term) and ρ_{2i} (correlation coefficient for the second term) will range from -.5 to .5.

b. Bivariate Student T Error

The Bivariate Student T, as in the single parameter case, poses a difficult test for the algorithms.

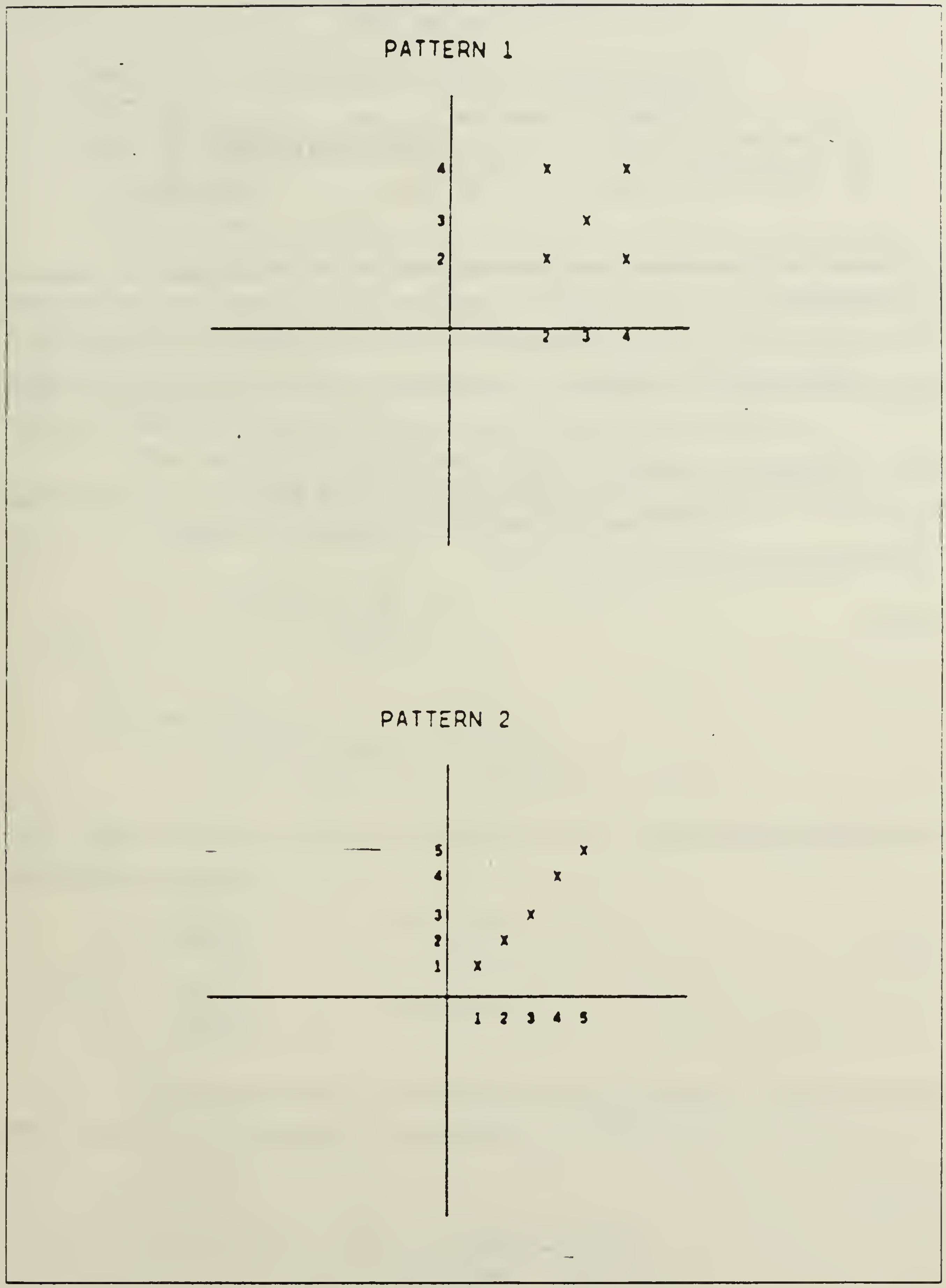

Figure 2.1 Patterns Used in Dual Parameter Model.

$$f_i(x_i, y_i/\underline{\theta}) = \frac{\Gamma\left[\frac{2+d_i}{2}\right]\frac{1}{\sigma_{x_i}\sigma_{y_i}\ (1-\rho_i^2)}}{\Gamma(d_i/2)\ \sqrt{4\pi}} \tag{2.6}$$

$$\cdot \left[1 + \frac{1}{d_i(1-\rho_i^2)}\left[\frac{(x_i-\theta_x)^2}{\sigma_{x_i}^2} - \frac{2\rho(x_i-\theta_x)(y_i-\theta_y)}{\sigma_{x_i}\sigma_{y_i}} + \frac{(y_i-\theta_y)^2}{\sigma_{y_i}^2}\right]\right]^{-\left[\frac{2+d_i}{2}\right]}$$

Equation 2.7 from Kotz and Johnson [Ref. 4:p. 129] was used to simulate the observations.

$$x_i = Z_i\,(Y/d_i)^{(1/2)}\,\sigma_i + \mu_j \tag{2.7}$$

where: Z_i is the i^{th} observation from a bivariate normal

Y is distributed chi-squared with d_i degrees of freedom

The values for ρ range from 0.5 to -0.5.

III. EXAMINATION OF METHODS

A. SINGLE PARAMETER CASE

1. Non-Bayesian

a. The Mean

The mean-nearest neighbor algorithm was incorporated into the study to examine how it compares to what we believe to be more robust estimators. Also, we can calculate the probability of a correct identification given normally distributed and mixed normally distributed error analytically. The mean considered here is a simple average of the observations and is done in the subroutine labeled MEAN.

If we assume the error is from a normal distribution, then we can calculate the probability of a correct answer for a specified number of observers using equation 3.1.

$$P_h = \int_{\mu_j-\phi/2}^{\mu_j+\phi/2} e^{-\frac{1}{2}\left[\frac{z-\mu_j}{\sigma_{\bar{x}}}\right]} \frac{d_z}{\sqrt{2\pi}\,\sigma_{\bar{x}}} \tag{3.1}$$

where $\phi = \mu_{j+1} - \mu_j$

σ = standard deviation of the mean

Then, using standard notation, the probability of a correct identification can be calculated by equation 3.2.

$$P_h = \begin{cases} 2\Phi\left[\dfrac{\phi}{2\sigma_{\bar{x}}}\right] - 1 & \text{for interior pts.} \\ \Phi\left[\dfrac{\phi}{2\sigma_{\bar{x}}}\right] & \text{for end pts.} \end{cases} \tag{3.2}$$

We can also solve for the $P(\text{hit}) = P_h$ when the error is assumed to be mixed normal by using equation 3.3 (assuming $\varepsilon_i = \varepsilon$, $i = 1,2,\ldots,I$)

$$P_h = \sum_{i=1}^{I} \binom{I}{i} \epsilon^{i} (1-\epsilon)^{I-i}\, \Phi\left[\frac{\phi/2}{\sqrt{\dfrac{(I-i)\sigma_1^2 + i\sigma_2^2}{I}}}\right] \tag{3.3}$$

The results for an interior point where σ_1 is 0.5, a σ_2 is 5 and when I is ranged from 2 to 20 is contained in Table 1. Note that as the number of observers goes from 2 to 6 that the probability of hit goes down! This trend reverses as the number of observers gets larger than 6. This is a result of the large outliers effect on the mean, as modelled by the ε contamination. In reflects the unfortunate non-robustness of the mean-nearest neighbor algorithm. The probability of getting a draw from the side of the mixed normal with a large scale increases with the number of observers. The mean can not overcome these big outliers with a limited number of observers, but eventually the central limit theorem effect takes over. This example strongly suggests that ordinary linear (mean-based) rules will be ineffective in the presence of outliers. The algorithm to compute the mean is contained in subroutine MEAN of Appendix B.

TABLE 1

P_H FOR MEAN WITH MIXED NORMAL ERROR

NUMBER OF OBSERVERS	P(HIT)
02	.54
03	.51
04	.49
05	.48
06	.47
07	.48
08	.49
09	.50
10	.51
11	.53
12	.54
13	.56
14	.57
15	.58
16	.60
17	.61
18	.62
19	.63
20	.64

b. The Weighted Mean

The weighted mean is identical to the average when the variances of all the observers are thought to be equal. But if the variances are believed to be different, then the observation from the watchers with the lower variance should carry more weight than those with a higher variance. Equation 3.4 is the appropriate weighted mean.

$$\hat{\theta} = \frac{\sum_{i=1}^{I} \frac{x_i}{\sigma_i^2}}{\sum_{i=1}^{I} \frac{1}{\sigma_i^2}} \tag{3.4}$$

c. The Median

The standard median was also introduced, as a simple robust estimator. The median has the advantage of requiring no prior knowledge of the sensors or the radars. Furthermore, we can approximate the probability of a correct guess. If we assume normally distributed error, then from Hodges and Lehman [Ref. 5:pp. 926-927] and Chu [Ref. 6:pp. 112-116] we get equation 3.5.

$$\text{Median} \sim N\left[\mu_i, \frac{\sigma_i^2}{I}\left[\frac{1}{\frac{2}{\pi} + \frac{a}{I}}\right]\right] \tag{3.5}$$

$$\text{where } a = \begin{cases} \frac{4}{\pi} - 1 & \text{if I is odd} \\ \frac{6}{\pi} - 1 & \text{if I is even} \end{cases}$$

The median is found by the computer function RMEDIAN, but is called by subroutine MEAN.

d. Voting Algorithm

The voting algorithm is a democratic process. For the present uniform parameter distribution this process picks the radar that has the most observations within 0.5 units of it. If there is no one radar that has more that the others than the median is chosen.

It is easy to see that this results in the same choice of a radar as the median for the two and three observer cases. The only advantage is when there are four or more observers. Then the ability of the voting algorithm is not to be mislead by two outlier observations that happen to be on the same side of the true value. On the other hand, any two observations(even if outliers) that are close to a μ_j will, more than likely result in that radar being identified as the one.

e. Biweights

The biweight procedure is a robust iterative process that uses the calculated $\hat{\theta}(t)$ to begin iteration $t+1$. Our first guess is at the median of the observations. The updating process proceeds as in equation 3.6.

$$\hat{\theta}(t) = \frac{\sum_{i=1}^{I} \omega_i x_i}{\sum_{i=1}^{I} \omega_i} \tag{3.6}$$

$$\text{where } \omega_i = \begin{cases} \left[1 + \left[\dfrac{x_i - \hat{\theta}(t-1)}{c\,S}\right]^2\right]^2 & \text{if } \left[\dfrac{x_i - \hat{\theta}(t-1)}{c\,S}\right]^2 < 1 \\ 0 & \text{otherwise} \end{cases}$$

$$S = \text{median}\ \{ |\, x_i - \theta(t-1)\, | \}$$

The constant c was set equal to 6, as recommended in Mosteller and Tukey [Ref. 7:p. 353] This algorithm is contained in subroutine BIWGHT of the simulation in Appendix B.

f. Maximum Likelihood Estimator Based on Mixed Normal

If we anticipate that all the observations have a mixed normal error distribution as described by equation 2.2, then the maximum likelihood method described in Mood, Graybill and Boes [Ref. 1:pp. 276-286] proceeds by equation 3.7.

$$L(\theta) = \prod_{i=1}^{I} (1-\epsilon_i) \frac{1}{\sqrt{2\pi}\,\sigma_{i1}} e^{-\frac{1}{2}\left[\frac{x_i - \theta}{\sigma_{i1}}\right]^2} + \epsilon_i \frac{1}{\sqrt{2\pi}\,\sigma_{i2}} e^{-\frac{1}{2}\left[\frac{x_i - \theta}{\sigma_{i2}}\right]^2} \tag{3.7}$$

Next we take the natural logarithm of equation 3.7 and rearrange terms resulting in equation 3.8.

$$\ell(\theta/\underline{x}) = \sum_{i=1}^{I} \mathrm{Ln}[\sqrt{2\pi}\,\sigma_{i2}]^2 - \frac{1}{2}\left[\frac{x_i-\hat{\theta}}{\sigma_{i2}}\right] \tag{3.8}$$

$$+ \mathrm{LN}\left[\epsilon_i + (1-\epsilon_i)\frac{\sigma_{i2}}{\sigma_{i1}}\, e^{-\frac{1}{2}(x_i-\hat{\theta})^2\left[\frac{1}{\sigma_{i1}^2} - \frac{1}{\sigma_{i2}^2}\right]}\right]$$

Differentiating both sides we get equation 3.9.

$$\frac{\partial\ell}{\partial\theta} = \sum_{i=1}^{I} \frac{(x_i-\hat{\theta})}{\sigma_{12}^2} + \frac{(1-\epsilon_i)\frac{\sigma_{12}}{\sigma_{11}}\exp\left[-\frac{1}{2}(x_i-\hat{\theta})^2\left[\frac{1}{\sigma_{11}^2}-\frac{1}{\sigma_{12}^2}\right]\right](x_i-\hat{\theta})\left[\frac{1}{\sigma_{11}^2}-\frac{1}{\sigma_{12}^2}\right]}{\epsilon_i+(1-\epsilon_i)\frac{\sigma_{12}}{\sigma_{11}}\exp\left[-\frac{1}{2}(x_i-\hat{\theta})^2\left[\frac{1}{\sigma_{11}^2}-\frac{1}{\sigma_{12}^2}\right]\right]} \tag{3.9}$$

We apply the iterative reweighting method similar to that used in the biweights to get equation 3.10.

$$0 = \frac{\partial\ell}{\partial\theta} = \sum_{i=1}^{I} (x_i-\hat{\theta})\left[\frac{1}{\sigma_{i2}^2} + \omega_i(\hat{\theta}(r))\left[\frac{1}{\sigma_{i1}^2}-\frac{1}{\sigma_{i2}^2}\right]\right] \tag{3.10}$$

$$\text{where } \omega_i(\hat{\theta}(r)) = \frac{(1-\epsilon_i)\frac{\sigma_{i2}}{\sigma_{i1}}\exp\left[-\frac{1}{2}(x_i-\theta(r))^2\left[\frac{1}{\sigma_{i1}^2}-\frac{1}{\sigma_{i2}^2}\right]\right]}{\epsilon_i+(1-\epsilon_i)\frac{\sigma_{i2}}{\sigma_{i1}}\exp\left[-\frac{1}{2}(x_i-\theta(r))^2\left[\frac{1}{\sigma_{i1}^2}-\frac{1}{\sigma_{i2}^2}\right]\right]}$$

As in the biweights, we again use the median of the observations as the starting point of our weighting.

The above method is carried out in subroutine EPSMLE. The process should converge and stop. For computer purposes, convergence is considered to be when $\theta'(t) = \theta'(t+1) + -.0001$. If the process did not converge by the 1000^{th} iteration, then it would stop and take the median. Also, a flag would be sent up to warn the operator that this run is not going to be as completely a result of the expected method.

g. Maximum Likelihood Estimator Based on Student t

The MLE based on the Student t assumes that each observation has a Student t error distribution. To solve the MLE we do the following:

$$L(\theta) = \prod_{i=1}^{I} \frac{c(d_i)}{\left[1 + \left[\frac{x_i - \theta}{\sigma_i}\right]^2 \frac{1}{d_i}\right]^{(d_i-1)/2}} \qquad (3.11)$$

Now taking the natural log we arrive at equation 3.12, after discarding irrelevent constants.

$$\ell(\theta|\underline{x}) = \sum_{i=1}^{I} \left[\frac{d_i+1}{2}\right] \ell n\left[1 + \left[\frac{x_i - \hat{\theta}}{\sigma_i}\right]^2 \frac{1}{d_i}\right] \qquad (3.12)$$

Unfortunately, this could have several solutions. We can usually get an appropriate solution using iterative reweighting. Again, the starting point will be the median of the observations. Note that if $\Theta(r)$ is replaced by the median of the observations, there will always be a unique solution.

$$0 = \frac{\partial \ell}{\partial \theta} = \sum_{i=1}^{I} (x_i - \hat{\theta}(r+1)) \frac{1}{\sigma_i^2} \omega_i(r) \qquad (3.13)$$

then

$$\hat{\theta}(r+1) = \frac{\sum_{i=1}^{I} \frac{x_i}{\sigma_i^2} \omega_i(r)}{\sum_{i=1}^{I} \frac{\omega_i(r)}{\sigma_i^2}} \qquad (3.14)$$

$$\text{where } \omega_i(r) = \frac{\frac{d_i+1}{d_i}}{\left[1 + \left[\frac{x_i - \hat{\theta}(r)}{\sigma_i}\right]^2 \frac{1}{d_i}\right]}$$

This procedure is carried out in subroutine TMLE. This method, as in the one above, stops when $\Theta'(t) = \Theta'(t+1) + -.0001$. If, after 1000 iterations, it has not converged, then it selected the median and set a flag as before.

h. Identification

In all the Non-Bayesian methods the resulting value was an estimate of the true value. To state which radar type we actually heard a comparison was made. This involved picking the radar type whose true value was closest to the estimated value. If the estimated value exceeded the largest μ_j or was less than the smallest μ_j, then the identified j would be the one on the appropriate tail. This is the nearest neighbor procedure.

2. Bayesian methods

a. Where x_i is Normally Distributed

There may be additional information that we want to take advantage of which was not incorporated in the preceding methods. That is, there might be assumed knowledge of the probability of a particular radar type being in the range of detection. For example, we may know that half of the radars in the area are of one particular type. Then, all else being equal, we would expect to gain detection of that particular type more often than on the others. We can use this information as the a priori probability for a Bayesian approach. With normally distributed observations the Bayes posterior is:

$$p_j^*(\theta) = kp_j \prod_{i=1}^{I} \frac{1}{\sqrt{2\pi}\,\sigma_i} \exp\left[-\frac{1}{2}\left(\frac{x_i-\mu_j}{\sigma_i}\right)^2\right] \tag{3.15}$$

Now, since we know that equation 3.16 is true,

$$\sum_{i=1}^{I} p_j m_j = 1 \tag{3.16}$$

$$\text{where } m_j = \exp\left[-\frac{1}{2}\left(\frac{x_i-\mu_j}{\sigma_i}\right)^2\right]$$

We can simplify to get equation 3.17.

$$p_j^*(\theta) = \frac{p_j m_j}{\sum_{i=1}^{I} p_j m_j} \tag{3.17}$$

The bayesian normal method is contained in subroutine NORMBY in Appendix B.

b. Where x_i has a Mixed Normal Distribution

If we contaminated the above error by adding, with some probability epsilon, wide outliers from a mixed normal distribution; then we can again solve for the posterior shown in equation 3.18.

$$p_j^*(\theta) = kp_j \prod_{i=1}^{I} (1-\epsilon_i)\frac{1}{\sqrt{2\pi}\,\sigma_{i1}} \exp\left[-\frac{1}{2}\left(\frac{x_i-\mu_j}{\sigma_{i1}}\right)^2\right] \tag{3.18}$$

$$+ \epsilon_i \frac{1}{\sqrt{2\pi}\,\sigma_{i2}} \exp\left[-\frac{1}{2}\left(\frac{x_i-\mu_j}{\sigma_{i2}}\right)^2\right] .$$

Now, rearranging terms and with appropriate cancellations:

$$p_j^*(\theta) = \frac{p_j m_j}{\sum_{j=1}^{J} p_j m_j} \tag{3.19}$$

where

$$m_j = \exp\left[\sum_{i=1}^{I} - LN(\sqrt{2\pi}\,\sigma_{i2}) - \frac{1}{2}\left[\frac{x_i-\theta_j}{\sigma_{i2}}\right]\right.$$

$$\left. + LN\left[\epsilon_i + (1-\epsilon_i)\frac{\sigma_{i2}}{\sigma_{i1}} e^{-\frac{1}{2}(x_i-\mu_j)^2\left[\frac{1}{\sigma_{i1}^2} - \frac{1}{\sigma_{i2}^2}\right]}\right]\right]$$

The Bayesian mixed normal method is contained in subroutine EPSBAY in Appendix B.

c. Where x_i has a Student t Distribution

We can follow the above arguments with a t-distributed error as well. Where equation 2.2 is the underlying model of the error. We substitute into the equation for the posterior and get equation 3.20.

$$p_j^*(\theta) = kp_j \prod_{i=1}^{I} \frac{c(d_i)}{\left[1 + \left[\frac{x_i - \mu_j}{\sigma_i}\right]^2 \frac{1}{d_i}\right]^{(d_i+1)/2}} \tag{3.20}$$

with appropriate cancellation we get equation 3.21.

$$p_j^*(\theta) = \frac{p_j m_j}{\sum_{i=1}^{I} p_j m_j} \tag{3.21}$$

where

$$m_j = \exp\left[-\frac{1}{2} \sum_{i=1}^{I} (d_i + 1)\, \ell n\left[1 + \left[\frac{x_i - \mu_j}{\sigma_i}\right]^2 \frac{1}{d_i}\right]\right]$$

This routine is performed in subroutine TBAYES in Appendix A.

B. TWO PARAMETER CASE

1. The Median Based Algorithm

Many of the algorithms used in the single parameter case can be generalized to more dimensions. We have limited ourselves to only four algorithms to be examined in the two parameter case. All four are non-bayesian and will be compared by their probability of correctly identifying a 2 parameter radar.

The first algorithm is a method based on the median. We proceed by finding the median of the I observations on the first parameter and the median of the observations on the second parameter. The euclidean distance from this pair to all the possible pairs is determined. Then we take the radar that is closest to the medians (the nearest neighbor) to be the radar that is sending.

This method is carried out in subroutine RMED.

2. Bivariate Normal Maximum Likelihood Estimator

If we assume the errors to have a bivariate normal distribution with known parameters, then we can calculate the likelihood of each parameter pair. This can be maximized to determine an estimate of the value in the usual way as shown in equation 3.22.

$$\ell(\theta) = \sum_{i=1}^{I} - LN(2\pi\sigma_{x_i}\sigma_{y_i}) - \frac{1}{2(1-\rho^2)} \cdot \left[\left[\frac{x_i-\mu_{x_j}}{\sigma_{x_i}}\right]^2 - 2\rho\left[\frac{x_i-\mu_{x_j}}{\sigma_{x_i}}\right]\left[\frac{y_i-\mu_{y_j}}{\sigma_{y_i}}\right] - \left[\frac{y_i-\mu_{y_j}}{\sigma_{y_i}}\right]^2\right] \tag{3.22}$$

This procedure is accomplished in subroutine NMLE2.

3. **Bivariate Mixed Normal Maximum Likelihood Estimator**

One would not expect the above method to be very robust. We can improve on this by expanding the algorithms of the single parameter case to the two parameter case. Equation 3.23 shows an MLE method based on the bivariate mixed normal distribution.

$$\ell(\theta) = LN(1-\epsilon_i)\frac{1}{2\pi\sigma_{1x_1}\sigma_{1y_1}\sqrt{(1-\rho_1^2)}}e^{-Q} + \epsilon_i\frac{1}{2\pi\sigma_{1x_1}\sigma_{1y_1}\sqrt{(1-\rho_1^2)}}e^{-Q} \tag{3.23}$$

$$\text{where } Q = \left[\frac{x_i-\mu_{x_j}}{\sigma_{1x_i}}\right]^2 - 2\rho_1\left[\frac{x_i-\mu_{x_j}}{\sigma_{1x_i}}\right]\left[\frac{x_i-\mu_{y_j}}{\sigma_{1y_i}}\right] + \left[\frac{x_i-\mu_{y_j}}{\sigma_{1y_i}}\right]^2$$

$$Q' = \left[\frac{x_i-\mu_{x_j}}{\sigma_{2x_i}}\right]^2 - 2\rho_2\left[\frac{x_i-\mu_{x_j}}{\sigma_{2x_i}}\right]\left[\frac{x_i-\mu_{y_j}}{\sigma_{2y_i}}\right] + \left[\frac{x_i-\mu_{y_j}}{\sigma_{2y_i}}\right]^2$$

This algorithm is contained in subroutine EPMLE2 in Appendix C.

4. Bivariate Student t Maximum Likelihood Estimator

Another algorithm can be created based on the bivariate t MLE. Using the bivariate Student t in equation 2.6 we can follow the basic mle method to construct the new estimator in equation 3.24.

$$\ell(\theta) = \sum_{i=1}^{I} -\frac{1}{2}\,LN[\sigma_1^2\sigma_2^2(1-\rho^2)] - \left[\frac{d_i+1}{2}\right] \tag{3.24}$$

$$\cdot\ LN\left[1+\left[\left[\frac{x_i-\mu_{x_i}}{\sigma_{x_i}}\right]^2 - 2\rho\left[\frac{x_i-\mu_{x_i}}{\sigma_{x_i}}\right]\left[\frac{y_i-\mu_{y_i}}{\sigma_{y_i}}\right]+\left[\frac{y_i-\mu_{y_i}}{\sigma_{y_i}}\right]^2\right]\frac{1}{d_i}\right]$$

This procedure is carried out in subroutine TMLE2 in Appendix C.

IV. CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

1. Observations

We examined several identification methods for the single and double parameter cases. Each algorithm was tested under various conditions of true and assumed (value used in the algorithms) scale, priors in the single parameter case, and pattern and correlation, ρ, in the two parameter case.

In the single parameter case we examined three Bayesian and seven non-Bayesian methods. The Bayesian methods included one based on a normal, one based on a mixed normal (with two different values for epsilon) and one based on a t (with three different values for degrees of freedom). The non-Bayesian methods included a simple average of the observations, a variance weighted mean, median of the observations, voting algorithm, biweight and MLE's based on the mixed normal and Student's t. As expected the Bayesian algorithms did slightly better than their non-Bayesian counterparts if the priors assumed by the Bayesian were correct. But, if the priors were not correct then the Bayesian methods were significantly mislead. Therefore, the Bayesian algorithms were not reconmended unless reliable priors are available or vague priors are used. The algorithms all displayed a tolerance to inaccurate scale parameters with only a 1 percent decline in the probability of identification. The mixed normal and Student's t based method (which were designed to handle outliers) did as well as the average and median on the normal based observations and significantly out performed them when the number of outliers was increased with the mixed normal and t error distributions. Therefore, for the single parameter case either the mixed normal or Student's t based MLE methods are the recommended procedures.

In the double parameter case we concentrated on the non-Bayesian methods. These methods included an algorithm based on the median and three MLE's; one assuming bivariate normal error, one assuming bivariate mixed normal error and the lasted assuming bivariate Student's t error. The probability of a correct identification was very dependent on the true correlation coefficient and pattern of the observations, in addition to the affects of the other elements in the single parameter case. As an example, a linear pattern in combination with a negative correlation, ρ, resulted in a 9

percent increase over the box pattern. But, a positive ρ in those conditions came up with 4 percent loss for the diagonal pattern compared to the box pattern. The algorithms adjusted well to inaccurate information, except for outliers. The normal mle and to a lesser extend the median could not cope with the outliers, when compared to the t or mixed normal based mle's. As in the single parameter case, the t or mixed normal based mle is strongly recommended as the algorithm of choice.

2. Areas for Further Research

There may be more information available to the user from these algorithms than just which radar is thought to be radiating. For the Bayesian there is a probability associated with each possible radar. We can also determine a posterior for the MLE methods. If we divide the value that results from solving the algorithm with the known parameters values in it, by the sum of all these values for all the radars, this gives a posterior equivalent to the Bayes if all a priori probabilities were equal, i.e., for a vague prior. These two methods can be used to indicate how confident we should be in a particular choice.

Another possiblity for the non-Bayesian estimates is the absolute deviation from the estimate of the parameter to each of the radars. For example, if the estimator was on the border line we should be less sure about identification than if it is directly on. Another method might be to remove the observation that is furthest away from the non Bayesian estimate. Then recompute the estimate based on one less observation. Do the results change significantly?

These procedures can also be generalized to include up to p ($p > 2$) parameters, while also permitting parameters to be missing from from the results of some of the observers. For example; observer 1 might record observations on the first and third parameters, observer two on the second an third and observer 3 on all of them. This case is not currently studied, but a liklihood-based analysis seems possible.

The affects of variance in the signal send by the radar also needs should be looked at. How does this affect the estimators? Are some more resistant than others?

APPENDIX A
SIMULATION RESULTS

1. SINGLE PARAMETER CASE

The following tables show the results for a wide range of possible cases that were investigated. The tables represent the outcomes for the probability of a particular algorithm correctly identifying the radar that is sending. Each entry is the result of 10 runs of 1000 trials each. The entries are expected to be within +- .01 of the true values. The tables show the results for the four error distributions: normal, mixed normal (epsilon=.1), mixed normal (epsilon=.25), and Cauchy. These are listed across the top pf the tables. Also, on the top are the number of observers used to both generate and analyze the data. Down the left side of each table are the algorithms and their associated degrees of freedom or epsilons. Those above the double lines are Bayesian and those below are non-Bayesian. More details and results from each table are presented in the following paragraphs.

Tables 2, 3 and 4 show the results from the best case, where the parameters used to analyze the observations are exactly correct. The only time this is not true is where, in the t based estimators or the mixed normal based estimators, the degrees of freedom or epsilon have been varied. These changes are represented in the left hand column. The priors for these tables were all equally likely. An observation was produced by selecting a mean, based on the priors, from those given; then generating the error from the appropriate distribution and finally adding the two. Each draw for a mean and error are independent of all the others.

Under ideal circumstances, the Bayesian methods have a slight advantage over the non-Bayesian procedures for larger numbers of observers, and a very significant edge for the lower number of observers. This was expected because of the additional information available to the Bayesian estimators. What is of more interest is the sensitivity of the algorithms to inaccuracies.

In tables 5 and 6 the sensitivity of the methods is compared. Here the error is generated with a variance or spread of 0.25 and the estimators assumed 0.09 or 0.49 respectively. The priors are all equal and the mean of the observation (radar in action) is selected at random from the 5 given.

We see that all the algorithms are fairly insensitive to changes in scale . But, of importance is the apparent lack of change in both the t and median algorithms. While the normal and mixed normal show a 2 to 3 point degradation.

In tables 7 and 8 we examine the effects of varying the scale parameters. That is to say, the true scale for the first receiver was 0.4, the scale for the second was 0.5, the scale for the third was 0.6, the fourth was 0.7 and the fifth was 0.8. The results in Table 7 show the probability of a correct identification when the correct scales are known and used in the algorithms. Table 8 shows the results if the correct scales are not known, but the average of the scale parameters is used. The difference is small.

Tables 9, 10, 11 display the results from simulation when the priors for the radars doing the announcing are inaccurate in various ways. For these radar 3 was always sending, but in table 9 the priors assumed by the Bayesian estimators were 0.15 for the first, 0.3 for the second, 0.1 for the third, 0.3 for the fourth, and 0.15 for the fifth. In Table 10 we were less accurate with the first having a prior probability of 0.3 , the second of 0.15, the third of 0.1, the fourth of 0.15 and the fifth of 0.3. Finally, we introduced a set of priors probabilities that was not symmetric with the first as .05, the second as 0.1, the third as 0.15, the fourth as 0.3 and the fifth as 0.4.

Changes in the priors created the largest degradation in the probabilities of making a correct identification. The Bayes procedures are extremely sensitive to inaccuracies in the priors. They lose the significant advantage they held in the two observer cases. The priors tend to draw away the Bayesian methods when the true signal is close to another signal that has a larger prior. This represents a particularly significant distraction to the Bayesian methods.

Tables 12 and 13 display the probabilities of correct identification if radar 1 is always sending or if radar 3 is always sending and the priors are assumed to be equally likely.

TABLE 2

P_H WITH SCALE PARAMETERS OF .3 AND PRIORS EQUAL

ERROR DISTRIBUTION

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.98	1	1	1	.88	.86	.85	.85	.72	.70	.68	.68	.72	.73	.72	.72
BAYES EP.1	.98	1	1	1	.94	.98	.99	1	.86	.93	.97	.98	.80	.88	.91	.94
BAYES E.25	.98	1	1	1	.94	.98	.99	1	.86	.93	.97	.98	.80	.88	.91	.93
BAYES T1DF	.98	1	1	1	.94	.98	.99	1	.85	.93	.96	.98	.81	.90	.93	.96
BAYES T3DF	.98	1	1	1	.93	.98	.99	1	.85	.92	.96	.97	.81	.90	.93	.96
BAYES T10D	.98	1	1	1	.92	.97	.98	.99	.80	.91	.94	.96	.79	.89	.91	.95
AVERAGE	.98	1	1	1	.88	.87	.85	.85	.73	.70	.69	.69	.73	.73	.73	.73
WEIGH MEAN	.98	1	1	1	.88	.87	.85	.85	.73	.70	.69	.69	.73	.73	.73	.73
MEDIAN	.98	.99	1	1	.88	.97	.98	.99	.73	.91	.92	.96	.73	.88	.89	.94
VOTING	.98	.99	1	1	.88	.97	.98	.99	.73	.91	.93	.96	.73	.88	.90	.94
BIWEIGHT	.98	.99	1	1	.88	.96	.98	.99	.73	.88	.91	.93	.73	.86	.89	.93
MLE T 1DF	.98	.99	1	1	.88	.98	.99	1	.73	.92	.94	.97	.74	.89	.91	.95
MLE T 3DF	.98	1	1	1	.88	.97	.98	1	.73	.91	.93	.96	.74	.89	.91	.95
MLE EPS .1	.98	1	1	1	.88	.98	.99	1	.73	.92	.94	.98	.73	.89	.90	.94
MLE EPS.25	.98	1	1	1	.88	.98	.99	1	.73	.92	.94	.98	.73	.88	.90	.94

NOTE:
1. PRIOR PROBABILITIES ARE ALL EQUAL
2. SCALE PARAMETER WAS .3 FOR ALL ERROR DISTRIBUTIONS
3. FOR MIXED NORMAL ERROR, 2nd SCALE WAS 3
4. THE ASSUMED SCALE WAS EQUAL TO THE TRUE SCALE
5. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
6. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 3

P_H WITH SCALE PARAMETERS OF .5 AND PRIORS EQUAL

	ERROR DISTRIBUTION															
	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.88	.93	.96	.98	.77	.78	.78	.77	.64	.60	.58	.57	.60	.59	.60	.60
BAYES EP.1	.88	.93	.96	.98	.82	.90	.94	.96	.75	.83	.88	.92	.67	.75	.79	.83
BAYES E.25	.87	.93	.96	.98	.82	.89	.94	.96	.75	.83	.88	.92	.67	.75	.79	.83
BAYES T1DF	.86	.92	.95	.97	.81	.88	.93	.95	.75	.82	.87	.91	.68	.77	.82	.86
BAYES T3DF	.88	.93	.96	.98	.82	.89	.93	.95	.74	.82	.86	.90	.67	.76	.81	.85
BAYES T10D	.88	.93	.96	.98	.80	.88	.92	.94	.70	.78	.83	.87	.65	.74	.79	.83
AVERAGE	.88	.93	.96	.98	.77	.78	.79	.77	.64	.61	.59	.58	.60	.60	.61	.60
WEIGH MEAN	.88	.93	.96	.98	.77	.78	.79	.77	.64	.61	.59	.58	.60	.60	.61	.60
MEDIAN	.88	.89	.95	.95	.77	.85	.91	.92	.64	.78	.81	.86	.60	.75	.78	.83
VOTING	.88	.89	.91	.95	.77	.85	.89	.91	.64	.78	.80	.85	.60	.75	.78	.83
BIWEIGHT	.88	.90	.94	.96	.77	.84	.91	.93	.64	.76	.81	.85	.60	.73	.77	.81
MLE T 1DF	.88	.91	.95	.97	.77	.88	.92	.95	.64	.81	.85	.90	.61	.76	.80	.85
MLE T 3DF	.88	.93	.96	.98	.77	.88	.92	.95	.65	.80	.84	.89	.61	.76	.80	.84
MLE EPS .1	.88	.93	.96	.98	.77	.89	.93	.96	.64	.82	.86	.91	.60	.74	.78	.82
MLE EPS.25	.88	.93	.96	.98	.77	.89	.93	.96	.64	.82	.86	.91	.60	.75	.78	.83

NOTE:

1. PRIOR PROBABILITIES ARE ALL EQUAL
2. SCALE PARAMETER WAS .5 FOR ALL ERROR DISTRIBUTIONS
3. FOR MIXED NORMAL ERROR, 2nd SCALE PARAMETER WAS 5
4. FOR T DISTRIBUTED ERROR, DEGREES OF FREEDOM WERE 1
5. THE ASSUMED SCALE EQUALED THE TRUE SCALE
6. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
7. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 4

P_H WITH SCALE PARAMETERS OF .7 AND PRIORS EQUAL

ERROR DISTRIBUTION

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.75	.83	.87	.91	.66	.69	.70	.71	.55	.52	.52	.50	.52	.51	.51	.51
BAYES EP.1	.75	.82	.87	.91	.71	.78	.84	.88	.64	.72	.77	.82	.58	.63	.68	.73
BAYES E.25	.75	.82	.87	.90	.71	.78	.83	.88	.64	.72	.78	.82	.58	.63	.69	.73
BAYES T1DF	.73	.80	.85	.88	.69	.76	.82	.86	.63	.71	.76	.80	.60	.66	.72	.77
BAYES T3DF	.75	.81	.87	.90	.71	.77	.83	.87	.64	.71	.76	.80	.58	.66	.71	.76
BAYES T10D	.75	.82	.87	.91	.69	.76	.81	.86	.60	.67	.73	.77	.55	.63	.68	.73
AVERAGE	.75	.83	.87	.91	.66	.69	.70	.71	.56	.53	.52	.51	.52	.52	.51	.52
WEIGH MEAN	.75	.83	.87	.91	.66	.69	.70	.71	.56	.53	.52	.51	.52	.52	.51	.52
MEDIAN	.75	.77	.84	.86	.66	.73	.79	.82	.56	.67	.71	.74	.52	.65	.68	.74
VOTING	.75	.77	.79	.85	.66	.73	.75	.81	.56	.67	.68	.72	.52	.65	.67	.73
BIWEIGHT	.75	.78	.84	.88	.66	.73	.81	.85	.56	.66	.72	.75	.52	.63	.67	.72
MLE T 1DF	.75	.79	.85	.88	.67	.75	.81	.85	.56	.69	.74	.79	.53	.66	.71	.77
MLE T 3DF	.75	.81	.87	.90	.67	.77	.82	.86	.56	.70	.74	.79	.53	.65	.70	.76
MLE EPS .1	.75	.82	.87	.91	.66	.78	.83	.88	.56	.71	.76	.82	.52	.63	.68	.73
MLE EPS.25	.75	.82	.87	.90	.66	.78	.83	.88	.56	.72	.76	.82	.52	.64	.68	.73

NOTE:

1. PRIOR PROBABILITIES ARE ALL EQUAL
2. SCALE PARAMETER WAS .7 FOR ALL ERROR DISTRIBUTIONS
3. FOR MIXED NORMAL ERROR, 2ND SCALE PARAMETER 49
4. FOR T DISTRIBUTED ERROR, DEGREES OF FREEDOM WERE 1
5. ASSUMED SCALE EQUALED THE TRUE SCALE
6. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
7. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 5

P_H WITH ASSUMED SCALE OF .3 AND TRUE SCALE OF .5

ERROR DISTRIBUTION

ALGORITHM	NORMAL 5/2	5/3	5/4	5/5	EPSILON .1 5/2	5/3	5/4	5/5	EPSILON .25 5/2	5/3	5/4	5/5	STUDENT T 1DF 5/2	5/3	5/4	5/5
BAYES NORM	.88	.94	.96	.98	.77	.78	.78	.77	.63	.59	.57	.55	.59	.59	.59	.59
BAYES EP.1	.84	.90	.93	.95	.80	.87	.91	.94	.73	.81	.86	.90	.65	.74	.79	.82
BAYES E.25	.83	.89	.92	.95	.79	.86	.90	.93	.72	.80	.85	.89	.64	.73	.78	.81
BAYES T1DF	.85	.91	.94	.96	.80	.88	.92	.95	.73	.81	.87	.91	.67	.77	.82	.86
BAYES T3DF	.87	.92	.95	.97	.82	.88	.93	.95	.74	.82	.87	.91	.68	.77	.83	.86
BAYES T10D	.87	.93	.96	.97	.82	.89	.93	.96	.74	.81	.87	.90	.67	.76	.81	.85
AVERAGE	.88	.94	.96	.98	.77	.78	.78	.77	.64	.61	.59	.58	.60	.60	.60	.60
WEIGH MEAN	.88	.94	.96	.98	.77	.78	.78	.77	.64	.61	.59	.58	.60	.60	.60	.60
MEDIAN	.88	.89	.95	.95	.77	.85	.90	.92	.64	.78	.82	.87	.60	.75	.78	.83
VOTING	.88	.89	.92	.95	.77	.85	.88	.92	.64	.78	.81	.86	.60	.75	.78	.82
BIWEIGHT	.88	.90	.94	.96	.77	.85	.91	.94	.64	.76	.82	.86	.60	.72	.77	.81
MLE T 1DF	.88	.90	.94	.96	.78	.87	.92	.94	.64	.80	.85	.89	.61	.76	.81	.85
MLE T 3DF	.88	.92	.96	.97	.78	.88	.93	.95	.64	.80	.85	.90	.61	.76	.81	.85
MLE EPS .1	.88	.89	.93	.95	.77	.87	.90	.93	.64	.80	.83	.89	.60	.75	.78	.83
MLE EPS.25	.88	.88	.92	.93	.77	.86	.89	.92	.64	.79	.81	.88	.60	.74	.77	.82

NOTE:

1. PRIOR PROBABILITIES ARE ALL EQUAL
2. TRUE SCALE PARAMETER WAS .5, FOR ALL ERROR DISTRIBUTIONS
3. FOR MIXED NORMAL ERROR, 2ND SCALE PARAMETER WAS 25
4. FOR T DISTRIBUTED ERROR, DEGREES OF FREEDOM WERE 1
5. ASSUMED SCALE WAS .3 FOR ALL ALGORITHMS
6. FOR MIXED NORMAL ASSUMED 2ND SCALE WAS 3
7. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
8. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 6

P_H WITH ASSUMED SCALE OF .7 AND TRUE SCALE OF .5

ERROR DISTRIBUTION.

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.88	.93	.96	.98	.77	.79	.78	.78	.63	.62	.59	.58	.60	.61	.60	.60
BAYES EP.1	.88	.93	.96	.98	.82	.89	.93	.95	.73	.81	.85	.89	.66	.74	.77	.81
BAYES E.25	.88	.93	.96	.98	.82	.89	.93	.96	.73	.82	.87	.91	.66	.75	.78	.82
BAYES T1DF	.87	.92	.95	.97	.82	.89	.93	.95	.74	.82	.87	.91	.68	.78	.81	.86
BAYES T3DF	.88	.93	.96	.98	.81	.89	.92	.95	.72	.81	.85	.89	.66	.77	.80	.85
BAYES T10D	.88	.93	.96	.98	.78	.86	.90	.93	.65	.75	.79	.83	.63	.72	.76	.80
AVERAGE	.88	.93	.96	.98	.77	.79	.78	.78	.63	.62	.59	.58	.60	.61	.60	.60
WEIGH MEAN	.88	.93	.96	.98	.77	.79	.78	.78	.63	.62	.59	.58	.60	.61	.60	.60
MEDIAN	.88	.89	.94	.95	.77	.86	.91	.92	.63	.78	.82	.86	.60	.76	.77	.84
VOTING	.88	.89	.91	.95	.77	.86	.89	.92	.63	.78	.81	.85	.60	.76	.77	.83
BIWEIGHT	.88	.90	.94	.96	.77	.85	.91	.93	.63	.77	.82	.86	.60	.74	.77	.81
MLE T 1DF	.88	.92	.95	.97	.77	.89	.92	.95	.63	.81	.85	.90	.61	.78	.80	.86
MLE T 3DF	.88	.93	.96	.98	.77	.88	.92	.95	.64	.80	.84	.88	.61	.76	.79	.84
MLE EPS .1	.88	.93	.96	.98	.77	.89	.92	.95	.63	.80	.84	.89	.60	.73	.76	.81
MLE EPS.25	.88	.93	.96	.98	.77	.89	.93	.96	.63	.81	.86	.90	.60	.74	.77	.82

NOTE:

1. PRIOR PROBABILITIES ARE ALL EQUAL
2. TRUE SCALE PARAMETER WAS .5, FOR ALL ERROR DISTRIBUTIONS
3. FOR MIXED NORMAL ERROR, 2ND SCALE PARAMETER WAS 25
4. FOR T DISTRIBUTED ERROR, DEGREES OF FREEDOM WERE 1
5. ASSUMED SCALE WAS .7 FOR THE ALGORITHMS
6. FOR MIXED NORMAL MLE 2ND SCALE WAS 7
7. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
8. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 7

P_H WITH SCALES VARYING FROM .4 FOR #1 TO .8 FOR #5

	ERROR DISTRIBUTION															
	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.91	.94	.96	.97	.80	.80	.78	.76	.66	.61	.58	.56	.64	.61	.60	.57
BAYES EP.1	.91	.94	.96	.96	.86	.91	.92	.94	.78	.84	.87	.88	.71	.76	.78	.80
BAYES E.25	.91	.94	.96	.96	.86	.90	.92	.94	.78	.84	.87	.89	.71	.76	.78	.80
BAYES T1DF	.90	.93	.95	.95	.86	.90	.91	.93	.78	.83	.86	.87	.72	.78	.81	.83
BAYES T3DF	.91	.94	.96	.96	.85	.90	.91	.93	.77	.82	.85	.87	.72	.78	.80	.82
BAYES T10D	.91	.94	.96	.97	.84	.89	.90	.92	.74	.79	.82	.83	.69	.75	.77	.79
AVERAGE	.90	.93	.94	.95	.80	.79	.76	.74	.66	.61	.57	.53	.63	.60	.58	.55
WEIGH MEAN	.91	.94	.96	.96	.80	.79	.77	.75	.66	.61	.58	.54	.63	.61	.59	.56
MEDIAN	.90	.90	.93	.92	.80	.86	.88	.88	.66	.78	.79	.81	.63	.76	.75	.79
VOTING	.90	.90	.90	.92	.80	.86	.86	.88	.66	.78	.78	.80	.63	.76	.75	.78
BIWEIGHT	.90	.90	.93	.93	.80	.86	.88	.89	.66	.77	.80	.81	.63	.73	.75	.77
MLE T 1DF	.90	.92	.94	.95	.82	.89	.90	.92	.70	.81	.84	.86	.67	.77	.78	.82
MLE T 3DF	.91	.94	.95	.96	.82	.89	.90	.93	.69	.81	.83	.85	.66	.77	.78	.82
MLE EPS .1	.91	.94	.96	.96	.82	.90	.92	.94	.70	.83	.85	.88	.65	.76	.77	.79
MLE EPS.25	.91	.94	.96	.96	.82	.90	.92	.94	.70	.83	.85	.88	.65	.76	.77	.80

NOTE:

1. PRIOR PROBABILITIES ARE ALL EQUAL
2. FOR ALL ERROR, SCALE PARAMETER WAS .4 FOR RECEIVER 1, .5 FOR RECEIVER 2, .6 FRO RECEIVER 3, .7 FOR RECEIVER 4, AND .8 FOR RECEIVER 5
3. THE SCALE OF THE SECOND TERM IN THE MIXED NORMAL WAS 10 TIMES THE FIRST SCALE
4. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
5. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 8

P_H TRUE SCALE GOES FROM .4 TO .8, ASSUMED SCALE IS AVR

ERROR DISTRIBUTION

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.91	.93	.94	.94	.79	.78	.75	.74	.65	.61	.57	.53	.63	.60	.58	.55
BAYES EP.1	.90	.93	.94	.94	.85	.89	.91	.92	.77	.82	.85	.87	.70	.75	.77	.78
BAYES E.25	.90	.93	.94	.94	.85	.89	.91	.92	.77	.83	.85	.87	.70	.75	.78	.79
BAYES T1DF	.89	.92	.93	.94	.85	.89	.90	.91	.77	.82	.85	.87	.71	.78	.80	.82
BAYES T3DF	.90	.93	.94	.95	.85	.89	.91	.92	.77	.81	.84	.86	.70	.77	.79	.81
BAYES T10D	.91	.93	.94	.95	.83	.88	.89	.90	.72	.78	.80	.82	.68	.74	.76	.77
AVERAGE	.91	.93	.94	.94	.79	.78	.76	.74	.66	.61	.57	.54	.63	.60	.58	.55
WEIGH MEAN	.91	.93	.94	.94	.79	.78	.76	.74	.66	.61	.57	.54	.63	.60	.58	.55
MEDIAN	.91	.90	.93	.92	.79	.86	.88	.88	.66	.78	.79	.82	.63	.75	.75	.79
VOTING	.91	.90	.89	.92	.79	.86	.86	.87	.66	.78	.78	.81	.63	.75	.75	.78
BIWEIGHT	.91	.90	.93	.93	.79	.85	.88	.89	.66	.76	.79	.81	.63	.73	.75	.76
MLE T 1DF	.91	.92	.93	.94	.79	.88	.90	.91	.66	.81	.82	.86	.64	.77	.79	.81
MLE T 3DF	.91	.93	.94	.94	.79	.88	.90	.91	.66	.80	.81	.85	.64	.76	.77	.80
MLE EPS .1	.91	.93	.94	.94	.79	.89	.90	.92	.66	.81	.83	.86	.63	.75	.76	.78
MLE EPS.25	.91	.92	.94	.94	.79	.89	.90	.92	.66	.82	.83	.87	.63	.75	.76	.78

NOTE:

1. PRIOR PROBABILITIES ARE ALL EQUAL
2. FOR ALL ERROR, SCALE PARAMETER WAS .4 FOR RECEIVER 1, .5 FOR RECEIVER 2, .6 FRO RECEIVER 3, .7 FOR RECEIVER 4, AND .8 FOR RECEIVER 5
3. THE SCALE OF THE SECOND TERM IN THE MIXED NORMAL WAS 10 TIMES THE FIRST SCALE
4. THE SCALE USED IN THE ALGORITHMS WAS THE AVERAGE OF THE SCALES FOR RECEIVERS IN USE
5. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
6. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 9

P_H PRIORS .15,.3,.1,.3,.15 RADARS ASSUMED .2 SCALE .5

ERROR DISTRIBUTION

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.69	.84	.92	.95	.58	.67	.68	.69	.45	.46	.45	.43	.39	.44	.46	.46
BAYES EP.1	.67	.82	.91	.95	.60	.76	.85	.91	.50	.65	.76	.82	.42	.55	.64	.71
BAYES E.25	.65	.80	.89	.94	.57	.74	.83	.90	.48	.63	.74	.81	.40	.53	.62	.70
BAYES T1DF	.55	.75	.85	.91	.48	.69	.78	.86	.39	.56	.68	.76	.33	.50	.59	.69
BAYES T3DF	.60	.79	.88	.93	.52	.72	.81	.88	.41	.58	.70	.77	.34	.51	.61	.71
BAYES T10D	.66	.82	.90	.95	.56	.73	.81	.88	.43	.57	.68	.75	.37	.52	.62	.70
AVERAGE	.84	.92	.96	.98	.71	.73	.73	.72	.54	.51	.49	.47	.50	.50	.50	.50
WEIGH MEAN	.84	.92	.96	.98	.71	.73	.73	.72	.54	.51	.49	.47	.50	.50	.50	.50
MEDIAN	.84	.87	.93	.94	.71	.82	.88	.90	.54	.72	.77	.82	.50	.69	.72	.79
VOTING	.84	.87	.89	.94	.71	.82	.85	.89	.54	.72	.76	.80	.50	.69	.70	.77
BIWEIGHT	.84	.87	.93	.95	.71	.82	.88	.92	.54	.70	.77	.81	.50	.65	.71	.77
MLE T 1DF	.84	.89	.94	.96	.71	.85	.90	.93	.55	.76	.82	.87	.51	.70	.76	.82
MLE T 3DF	.84	.91	.95	.97	.72	.86	.90	.94	.56	.75	.80	.86	.52	.70	.75	.81
MLE EPS .1	.84	.91	.95	.97	.71	.87	.91	.95	.54	.77	.82	.89	.50	.68	.73	.79
MLE EPS.25	.84	.91	.95	.97	.71	.87	.91	.95	.54	.78	.83	.89	.50	.68	.74	.80

NOTE:

1. RADAR 3 WAS ALWAYS SENDING
2. THE ASSUMED PRIOR PROBABILITIES, BIRD 1 WAS .15, BIRD 2 WAS .3 BIRD 3 WAS .1, BIRD 4 WAS .3, BIRD 5 WAS .15
3. FOR ALL ERROR, SCALE PARAMETER WAS .5
4. THE SCALE OF THE SECOND TERM IN THE MIXED NORMAL WAS 10 TIMES THE FIRST SCALE
5. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
6. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 10

P_H PRIORS .3,.15,.1,.15,.3 ASSUMED .2 SCALE .5

ERROR DISTRIBUTION

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 10F			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.80	.90	.94	.97	.68	.70	.72	.71	.51	.49	.47	.45	.46	.49	.48	.49
BAYES EP.1	.80	.89	.94	.96	.73	.83	.90	.94	.63	.75	.83	.87	.52	.64	.71	.77
BAYES E.25	.79	.88	.93	.96	.71	.82	.90	.93	.62	.74	.82	.87	.50	.63	.71	.76
BAYES T10F	.73	.86	.91	.95	.65	.80	.87	.92	.55	.70	.79	.84	.46	.64	.71	.78
BAYES T30F	.77	.88	.93	.96	.68	.81	.89	.93	.57	.71	.80	.85	.48	.65	.71	.78
BAYES T100	.80	.89	.94	.96	.69	.80	.88	.92	.55	.68	.76	.81	.48	.64	.69	.75
AVERAGE	.85	.92	.95	.97	.72	.72	.73	.72	.54	.51	.49	.47	.50	.51	.50	.50
WEIGH MEAN	.85	.92	.95	.97	.72	.72	.73	.72	.54	.51	.49	.47	.50	.51	.50	.50
MEDIAN	.85	.87	.93	.94	.72	.81	.88	.90	.54	.72	.77	.82	.50	.69	.72	.79
VOTING	.85	.87	.88	.93	.72	.81	.85	.89	.54	.72	.76	.80	.50	.69	.71	.77
BIWEIGHT	.85	.87	.93	.95	.72	.81	.89	.92	.54	.70	.78	.81	.50	.67	.71	.77
MLE T 10F	.85	.90	.94	.96	.72	.84	.90	.93	.55	.76	.82	.87	.51	.71	.76	.82
MLE T 3DF	.85	.91	.95	.97	.72	.85	.91	.94	.56	.75	.81	.86	.51	.70	.75	.81
MLE EPS .1	.85	.91	.95	.97	.72	.86	.92	.95	.54	.78	.83	.89	.50	.68	.72	.79
MLE EPS.25	.85	.91	.95	.97	.72	.86	.91	.95	.54	.78	.83	.89	.50	.69	.73	.79

NOTE:

1. RADAR 3 WAS ALWAYS SENDING
2. THE ASSUMED PRIOR PROBABILITIES, BIRD 1 WAS .3, BIRD 2 WAS .15 BIRD 3 WAS .1, BIRD 4 WAS .15, BIRD 5 WAS .3
3. FOR ALL ERROR, SCALE PARAMETER WAS .5
4. THE SCALE OF THE SECOND TERM IN THE MIXED NORMAL WAS 10 TIMES THE FIRST SCALE
5. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
6. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 11

P_H PRIORS .05,.1,.15,.3,.4 ASSUMED .2 SCALE .5

ERROR DISTRIBUTION

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.81	.91	.94	.97	.70	.73	.73	.71	.52	.50	.48	.47	.48	.49	.49	.50
BAYES EP.1	.81	.90	.94	.97	.76	.86	.91	.94	.65	.77	.84	.89	.56	.67	.73	.78
BAYES E.25	.80	.89	.94	.96	.75	.86	.90	.94	.65	.77	.83	.89	.56	.67	.73	.78
BAYES T1DF	.76	.87	.92	.95	.72	.83	.89	.92	.63	.74	.81	.88	.55	.68	.74	.80
BAYES T3DF	.79	.89	.93	.97	.73	.84	.90	.93	.63	.75	.81	.87	.56	.68	.74	.80
BAYES T10D	.81	.90	.94	.97	.73	.83	.89	.92	.59	.71	.77	.84	.53	.65	.72	.77
AVERAGE	.84	.92	.95	.97	.71	.74	.74	.72	.54	.51	.49	.48	.50	.50	.49	.50
WEIGH MEAN	.84	.92	.95	.97	.71	.74	.74	.72	.54	.51	.49	.48	.50	.50	.49	.50
MEDIAN	.84	.86	.93	.94	.71	.81	.88	.90	.54	.73	.76	.84	.50	.69	.73	.79
VOTING	.84	.86	.88	.94	.71	.81	.85	.89	.54	.73	.75	.81	.50	.69	.71	.76
BIWEIGHT	.84	.86	.93	.95	.71	.81	.88	.92	.54	.71	.77	.82	.50	.66	.72	.77
MLE T 1DF	.84	.89	.94	.96	.72	.85	.90	.93	.54	.76	.81	.88	.51	.71	.76	.82
MLE T 3DF	.84	.91	.95	.97	.72	.85	.90	.94	.55	.76	.80	.87	.51	.70	.75	.81
MLE EPS .1	.84	.91	.95	.97	.71	.88	.91	.95	.54	.78	.82	.90	.50	.68	.73	.79
MLE EPS.25	.84	.91	.95	.97	.71	.87	.91	.95	.54	.78	.83	.90	.50	.68	.73	.79

NOTE:

1. RADAR 3 WAS ALWAYS SENDING
2. THE ASSUMED PRIOR PROBABILITIES, BIRD 1 WAS .05, BIRD 2 WAS .1 BIRD 3 WAS .15, BIRD 4 WAS .3, BIRD 5 WAS .4
3. FOR ALL ERROR, SCALE PARAMETER WAS .5
4. THE SCALE OF THE SECOND TERM IN THE MIXED NORMAL WAS 10 TIMES THE FIRST SCALE
5. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
6. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 12

P_H FOR AN END RADAR SIGNALING SCALE .5

	ERROR DISTRIBUTION															
	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.92	.96	.98	.99	.85	.87	.87	.87	.78	.76	.76	.78	.77	.79	.81	.82
BAYES EP.1	.92	.96	.98	.99	.87	.93	.96	.97	.82	.89	.92	.95	.76	.82	.87	.89
BAYES E.25	.92	.95	.97	.98	.87	.93	.96	.97	.82	.89	.92	.95	.76	.82	.87	.89
BAYES T1DF	.91	.95	.97	.98	.87	.93	.96	.97	.82	.88	.92	.94	.78	.85	.88	.91
BAYES T3DF	.92	.96	.97	.98	.88	.93	.96	.97	.82	.88	.91	.94	.78	.85	.88	.91
BAYES T1DD	.92	.96	.98	.99	.86	.92	.95	.96	.8D	.86	.89	.92	.77	.84	.87	.89
AVERAGE	.92	.96	.98	.99	.85	.86	.86	.86	.77	.75	.74	.75	.75	.75	.75	.74
WEIGH MEAN	.92	.96	.98	.99	.85	.86	.86	.86	.77	.75	.74	.75	.75	.75	.75	.74
MEDIAN	.92	.93	.97	.97	.85	.91	.94	.95	.77	.86	.89	.92	.75	.85	.86	.89
VOTING	.92	.93	.97	.97	.85	.91	.95	.95	.77	.86	.89	.92	.75	.85	.87	.89
BIWEIGHT	.92	.94	.96	.97	.85	.90	.95	.96	.77	.85	.89	.91	.75	.83	.86	.89
MLE T 1DF	.92	.94	.97	.98	.85	.92	.95	.96	.77	.87	.88	.93	.74	.85	.86	.9D
MLE T 3DF	.92	.95	.97	.98	.85	.92	.95	.96	.76	.87	.89	.93	.74	.84	.86	.89
MLE EPS .1	.92	.96	.98	.99	.85	.93	.96	.97	.77	.89	.92	.95	.75	.84	.86	.89
MLE EPS.25	.92	.95	.97	.98	.85	.93	.96	.97	.77	.89	.91	.95	.75	.84	.87	.9D

NOTE:

1. RADAR 1 WAS ALWAYS SENDING
2. THE ASSUMED PRIOR PROBABILITIES WERE ALL EQUAL AT .2
3. FOR ALL ERROR, SCALE PARAMETER WAS .5
4. THE SCALE OF THE SECOND TERM IN THE MIXED NORMAL WAS 1D TIMES THE FIRST SCALE
5. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 10D0 TRAILS EACH
6. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

TABLE 13

P_H FOR AN INTERIOR POINT SCALE .5 ASSUMED PRIORS .2

ERROR DISTRIBUTION

	NORMAL				EPSILON .1				EPSILON .25				STUDENT T 1DF			
ALGORITHM	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
BAYES NORM	.84	.91	.96	.97	.71	.72	.72	.72	.54	.51	.48	.48	.49	.50	.50	.49
BAYES EP.1	.84	.91	.95	.97	.78	.87	.92	.95	.70	.79	.85	.90	.61	.69	.75	.79
BAYES E.25	.83	.90	.95	.97	.78	.87	.92	.94	.70	.79	.86	.90	.61	.70	.75	.80
BAYES T1DF	.82	.89	.94	.96	.77	.85	.91	.94	.69	.78	.84	.89	.62	.71	.78	.82
BAYES T3DF	.84	.90	.95	.97	.77	.86	.91	.94	.68	.77	.84	.89	.60	.71	.77	.82
BAYES T10D	.84	.91	.95	.98	.75	.83	.89	.93	.63	.72	.79	.85	.56	.68	.73	.79
AVERAGE	.84	.91	.96	.97	.71	.72	.72	.72	.54	.51	.49	.48	.49	.50	.50	.50
WEIGH MEAN	.84	.91	.96	.97	.71	.72	.72	.72	.54	.51	.49	.48	.49	.50	.50	.50
MEDIAN	.84	.86	.93	.94	.71	.81	.88	.90	.54	.73	.77	.83	.49	.69	.72	.79
VOTING	.84	.86	.89	.94	.71	.81	.85	.89	.54	.73	.76	.81	.49	.69	.71	.77
BIWEIGHT	.84	.87	.93	.95	.71	.81	.88	.91	.54	.70	.77	.82	.49	.65	.72	.76
MLE T 1DF	.84	.89	.94	.96	.71	.84	.90	.93	.55	.76	.81	.87	.51	.70	.76	.81
MLE T 3DF	.84	.90	.95	.97	.71	.85	.90	.93	.56	.75	.80	.87	.51	.70	.74	.81
MLE EPS .1	.84	.91	.95	.97	.71	.86	.92	.95	.54	.77	.82	.89	.49	.68	.73	.78
MLE EPS.25	.84	.90	.95	.97	.71	.86	.91	.95	.54	.77	.82	.89	.49	.69	.73	.79

NOTE:

1. RADAR 3 WAS ALWAYS SENDING
2. THE ASSUMED PRIOR PROBABILITIES WERE ALL EQUAL AT .2
3. FOR ALL ERROR, SCALE PARAMETER WAS .5
4. THE SCALE OF THE SECOND TERM IN THE MIXED NORMAL WAS 10 TIMES THE FIRST SCALE
5. ALL ENTRIES ARE THE AVERAGE OF 10 RUNS OF 1000 TRAILS EACH
6. ALL ENTRIES WERE ROUNDED OFF TO 2 DIGITS

2. MULTIPLE PARAMETER CASE

The following tables are the results for the two parameter simulations. Each table represents a particular case of interest. The entries are the percentage of correct identifications for 2000 trials.

The tables contain several different conditions each. Across the top of each table we see that the first subdivision is rho. This represents the value of rho used to compute the error or "true" rho. Rho ranged from -.5 to .5. Directly below the rho(ρ) are the number of radars/ number of observers used in to both generate and analyze the data. The left hand column is again broken down into two parts. The large subdivision is the value of epsilon used to produce the errors. This ranged from 0 (the bivariate normal) to .25. The next subdivision is the particular algorithm used to identify the radar and it's associated epsilon or degrees-of-freedom component.

In order to understand the abilities of the particular algorithms we examined a large number of situations. We looked at two patterns, box and diagonal, under various condition of changing true and assumed(what was used by the algorithms) rho and sigmas.

The tables below contain the results for the probability of hit. They are divided into two large groups, the first is for the diagonal pattern and the second the box pattern. Each pattern based group is further divided by the scale used to generate the error, "true scale", The combinations of scale parameters for the x and y components were (.5,.5), (.3,.7), and (.9,.9). With in each set of true scales there are different scales used for the algorithms, "assumed scale". The true scale set of (.3,.7) were (.5,.5) and (.3,.7). Finally, all the combinations were evaluated for rho of -.5, 0 and .5.

TABLE 14

P_H FOR A SCALE 0.5, ASSUMED RHO = 0.5, LINE PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON = 0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.92	.94	.98	.98	.96	.97	.99	.99	1	.99	1	1
NORMMLE	.92	.96	.99	.99	.96	.99	.99	1	1	1	1	1
TMLE 1DF	.90	.95	.98	.99	.94	.98	.99	1	1	1	1	1
TMLE 3DF	.92	.95	.98	.99	.96	.98	.99	1	1	1	1	1
TMLE 10DF	.92	.96	.99	.99	.96	.99	.99	1	1	1	1	1
EPMLE .1	.92	.96	.99	.99	.96	.99	.99	1	1	1	1	1
EPMLE .25	.92	.96	.99	.99	.96	.99	.99	1	1	1	1	1
EPSILON = .1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.82	.91	.95	.96	.85	.93	.96	.98	.87	.97	.97	.99
NORMMLE	.82	.81	.83	.84	.85	.84	.83	.83	.87	.85	.84	.82
TMLE 1DF	.87	.94	.96	.97	.92	.97	.98	1	.97	.99	1	1
TMLE 3DF	.88	.94	.97	.98	.93	.97	.98	.99	.97	.99	1	1
TMLE 10DF	.88	.94	.97	.97	.92	.96	.98	.99	.95	.99	.99	1
EPMLE .1	.89	.94	.97	.98	.93	.97	.99	1	.97	.99	1	1
EPMLE .25	.89	.94	.97	.98	.93	.97	.99	1	.97	.99	1	1
EPSILON = .25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.85	.86	.92	.70	.87	.88	.93	.73	.88	.89	.94
NORMMLE	.68	.67	.65	.68	.70	.67	.67	.65	.73	.68	.67	.65
TMLE 1DF	.82	.91	.93	.97	.86	.94	.97	.98	.93	.96	.98	.99
TMLE 3DF	.82	.91	.93	.96	.86	.94	.96	.98	.92	.95	.98	.99
TMLE 10DF	.80	.89	.92	.96	.85	.91	.94	.96	.89	.92	.96	.98
EPMLE .1	.83	.92	.94	.97	.87	.94	.97	.98	.93	.97	.98	.99
EPMLE .25	.83	.92	.94	.97	.87	.95	.97	.98	.93	.97	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.63	.79	.82	.87	.69	.83	.86	.91	.77	.88	.90	.93
NORMMLE	.63	.63	.65	.64	.69	.68	.70	.69	.77	.77	.74	.76
TMLE 1DF	.78	.84	.89	.91	.80	.89	.94	.95	.88	.94	.97	.98
TMLE 3DF	.76	.84	.88	.91	.80	.89	.94	.94	.88	.94	.96	.98
TMLE 10DF	.75	.80	.85	.89	.79	.87	.92	.94	.87	.93	.95	.97
EPMLE .1	.76	.81	.86	.89	.80	.87	.92	.94	.87	.92	.95	.97
EPMLE .25	.76	.82	.87	.89	.79	.87	.92	.94	.87	.92	.96	.97

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
3. DIAGONAL PATTERN
4. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 15

P_H FOR A SCALE 0.5, ASSUMED RHO 0.0, LINE PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.91	.94	.97	.98	.97	.98	.99	.99	1	.99	1	1
NORMMLE	.91	.97	.98	.99	.97	.99	1	1	1	1	1	1
TMLE 1DF	.90	.95	.97	.98	.96	.99	1	1	.99	1	1	1
TMLE 3DF	.91	.96	.97	.99	.97	.99	1	1	1	1	1	1
TMLE 10DF	.91	.97	.98	.99	.97	.99	1	1	1	1	1	1
EPMLE .1	.91	.96	.98	.99	.97	.99	1	1	1	1	1	1
EPMLE .25	.90	.96	.97	.99	.97	.99	1	1	.99	1	1	1
EPSILON= .1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.81	.89	.94	.96	.86	.94	.96	.98	.88	.96	.98	.99
NORMMLE	.81	.81	.83	.81	.86	.85	.83	.82	.88	.85	.84	.84
TMLE 1DF	.87	.92	.97	.97	.93	.97	.98	.99	.97	.99	1	1
TMLE 3DF	.88	.92	.97	.98	.93	.97	.98	.99	.96	.99	1	1
TMLE 10DF	.88	.92	.96	.98	.93	.97	.98	.99	.95	.99	.99	1
EPMLE .1	.89	.93	.97	.98	.94	.97	.99	1	.97	.99	1	1
EPMLE .25	.89	.93	.97	.98	.94	.97	.99	.99	.97	.99	1	1
EPSILON= .25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.85	.86	.92	.72	.85	.88	.94	.73	.88	.89	.94
NORMMLE	.68	.67	.66	.67	.72	.68	.66	.65	.73	.67	.66	.64
TMLE 1DF	.82	.89	.93	.95	.89	.92	.97	.97	.93	.97	.99	.99
TMLE 3DF	.82	.89	.93	.95	.88	.93	.97	.97	.92	.96	.98	.99
TMLE 10DF	.81	.88	.92	.95	.86	.91	.95	.96	.89	.93	.97	.98
EPMLE .1	.83	.89	.94	.96	.90	.94	.97	.98	.93	.96	.98	1
EPMLE .25	.83	.89	.93	.96	.89	.94	.97	.98	.93	.97	.98	1
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.63	.78	.80	.88	.67	.83	.85	.91	.78	.88	.91	.94
NORMMLE	.63	.62	.62	.64	.67	.69	.68	.69	.78	.77	.78	.75
TMLE 1DF	.76	.82	.87	.92	.82	.88	.93	.95	.91	.94	.97	.98
TMLE 3DF	.76	.82	.87	.92	.82	.88	.92	.95	.90	.94	.97	.98
TMLE 10DF	.73	.80	.86	.90	.80	.87	.91	.94	.89	.93	.96	.98
EPMLE .1	.74	.80	.85	.90	.80	.87	.91	.94	.89	.93	.96	.98
EPMLE .25	.74	.81	.85	.90	.80	.87	.91	.94	.89	.93	.96	.98

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0.
3. DIAGONAL PATTERN
4. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 16

P_H FOR A SCALE 0.5, ASSUMED RHO OF -.5, LINE PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.92	.95	.97	.98	.96	.97	.99	.99	1	1	1	1
NORMMLE	.92	.97	.98	.99	.96	.99	.99	1	1	1	1	1
TMLE 1DF	.89	.95	.97	.99	.95	.98	1	1	.99	1	1	1
TMLE 3DF	.91	.96	.98	.99	.96	.98	1	1	.99	1	1	1
TMLE 10DF	.91	.96	.98	.99	.96	.99	.99	1	1	1	1	1
EPMLE .1	.89	.94	.97	.99	.95	.98	1	1	1	1	1	1
EPMLE .25	.88	.94	.96	.98	.94	.98	.99	1	.99	1	1	1
EPSILON= .1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.82	.90	.95	.96	.86	.94	.96	.98	.87	.97	.98	.99
NORMMLE	.82	.83	.82	.83	.86	.85	.83	.84	.87	.87	.84	.83
TMLE 1DF	.88	.92	.96	.98	.93	.97	.98	.99	.98	.99	1	1
TMLE 3DF	.89	.93	.96	.98	.93	.97	.99	1	.98	.99	1	1
TMLE 10DF	.89	.93	.96	.98	.93	.97	.98	.99	.97	.99	.99	1
EPMLE .1	.87	.92	.96	.97	.93	.97	.99	.99	.98	1	1	1
EPMLE .25	.87	.91	.95	.97	.93	.97	.98	.99	.98	1	1	1
EPSILON= .25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.82	.85	.92	.71	.86	.87	.94	.72	.89	.88	.95
NORMMLE	.69	.68	.64	.66	.71	.68	.66	.66	.72	.67	.66	.66
TMLE 1DF	.82	.88	.92	.95	.87	.93	.97	.98	.93	.97	.99	.99
TMLE 3DF	.83	.88	.92	.95	.87	.93	.97	.98	.92	.97	.99	.99
TMLE 10DF	.83	.87	.92	.95	.87	.92	.96	.97	.90	.95	.98	.99
EPMLE .1	.82	.88	.92	.96	.87	.94	.97	.98	.93	.98	.99	1
EPMLE .25	.81	.88	.91	.95	.87	.94	.97	.98	.93	.98	.99	1
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.63	.79	.82	.87	.68	.83	.85	.92	.76	.89	.91	.94
NORMMLE	.63	.64	.64	.63	.68	.69	.70	.70	.76	.76	.78	.77
TMLE 1DF	.76	.81	.87	.91	.81	.89	.93	.96	.89	.94	.97	.98
TMLE 3DF	.76	.82	.88	.91	.81	.89	.93	.96	.89	.94	.97	.98
TMLE 10DF	.75	.81	.87	.90	.79	.87	.92	.95	.88	.93	.97	.98
EPMLE .1	.74	.80	.85	.88	.79	.88	.91	.95	.88	.93	.97	.98
EPMLE .25	.74	.80	.85	.88	.79	.88	.91	.94	.88	.93	.97	.97

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
3. DIAGONAL PATTERN
4. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 17

P_H SCALE .5, ASSUMED RHO OF .5, LINE PATTERN, RADAR 3

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.90	.93	.97	.98	.95	.97	.99	.99	1	.99	1	1
NORMMLE	.90	.96	.98	.99	.95	.99	.99	1	1	1	1	1
TMLE 1DF	.87	.94	.97	.99	.94	.98	.99	.99	.99	1	1	1
TMLE 3DF	.89	.95	.98	.99	.95	.99	.99	1	.99	1	1	1
TMLE 10DF	.89	.96	.98	.99	.95	.99	.99	1	.99	1	1	1
EPMLE .1	.90	.96	.98	.99	.95	.99	.99	1	.99	1	1	1
EPMLE .25	.89	.96	.98	.99	.95	.98	.99	1	.99	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.75	.88	.94	.95	.81	.93	.96	.97	.85	.96	.96	.99
NORMMLE	.75	.78	.78	.77	.81	.80	.79	.80	.85	.81	.79	.80
TMLE 1DF	.84	.92	.96	.97	.90	.96	.98	.99	.97	.99	1	1
TMLE 3DF	.85	.92	.96	.98	.90	.97	.98	.99	.97	.98	1	1
TMLE 10DF	.84	.91	.96	.98	.89	.96	.98	.99	.95	.97	.99	1
EPMLE .1	.85	.92	.96	.98	.91	.97	.98	.99	.97	.99	1	1
EPMLE .25	.85	.92	.96	.98	.91	.97	.98	.99	.97	.99	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.59	.81	.83	.90	.62	.82	.85	.93	.66	.85	.87	.93
NORMMLE	.59	.57	.58	.57	.62	.59	.57	.58	.66	.59	.59	.57
TMLE 1DF	.78	.86	.92	.95	.84	.91	.96	.98	.89	.95	.98	.99
TMLE 3DF	.78	.87	.93	.95	.83	.91	.95	.98	.89	.94	.97	.99
TMLE 10DF	.76	.85	.91	.94	.80	.89	.94	.96	.85	.92	.96	.97
EPMLE .1	.79	.88	.93	.96	.84	.93	.96	.98	.90	.95	.98	.99
EPMLE .25	.79	.88	.93	.96	.84	.93	.97	.98	.90	.96	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.53	.74	.76	.85	.61	.80	.81	.89	.69	.84	.87	.93
NORMMLE	.53	.54	.54	.56	.61	.63	.61	.62	.69	.69	.71	.73
TMLE 1DF	.71	.81	.85	.90	.76	.86	.90	.94	.84	.91	.95	.98
TMLE 3DF	.70	.80	.85	.90	.75	.86	.90	.94	.84	.91	.95	.98
TMLE 10DF	.68	.78	.83	.89	.73	.85	.89	.93	.83	.89	.95	.98
EPMLE .1	.70	.79	.83	.87	.75	.84	.88	.92	.83	.89	.93	.97
EPMLE .25	.70	.79	.83	.88	.75	.84	.89	.93	.83	.89	.93	.97

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
3. RADAR NUMBER 3 WAS ALWAYS SENDING
4. DIAGONAL PATTERN
5. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 18

P_H SCALE 0.5, ASSUMED RHO OF 0, LINE PATTERN, RADAR 3

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.89	.92	.97	.98	.96	.97	.99	.99	.99	.99	1	1
NORMMLE	.89	.95	.98	.99	.96	.99	1	1	.99	1	1	1
TMLE 1DF	.87	.93	.97	.99	.96	.98	.99	1	.99	1	1	1
TMLE 3DF	.88	.94	.98	.99	.96	.99	1	1	.99	1	1	1
TMLE 10DF	.89	.95	.98	.99	.97	.99	1	1	.99	1	1	1
EPMLE .1	.89	.94	.98	.99	.96	.99	1	1	.99	1	1	1
EPMLE .25	.89	.94	.98	.99	.96	.99	1	1	.99	1	1	1
EPSILON= .1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.78	.87	.93	.96	.82	.91	.95	.98	.85	.96	.96	.98
NORMMLE	.78	.78	.78	.78	.82	.80	.79	.79	.85	.83	.79	.80
TMLE 1DF	.85	.92	.95	.97	.93	.96	.98	.99	.96	.99	1	1
TMLE 3DF	.85	.92	.95	.98	.92	.96	.98	.99	.96	.99	1	1
TMLE 10DF	.85	.92	.95	.97	.92	.95	.98	.99	.94	.98	.99	1
EPMLE .1	.86	.92	.96	.98	.93	.97	.99	.99	.97	.99	1	1
EPMLE .25	.86	.92	.96	.98	.93	.97	.99	.99	.97	.99	1	1
EPSILON= .25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.60	.81	.82	.89	.61	.84	.83	.91	.68	.87	.86	.93
NORMMLE	.60	.60	.56	.58	.61	.60	.59	.58	.68	.60	.57	.57
TMLE 1DF	.77	.87	.92	.96	.84	.93	.96	.98	.92	.96	.98	.99
TMLE 3DF	.78	.88	.93	.96	.84	.93	.95	.97	.91	.96	.98	.99
TMLE 10DF	.76	.87	.91	.95	.81	.91	.94	.96	.88	.93	.96	.98
EPMLE .1	.78	.88	.94	.96	.85	.93	.97	.98	.92	.97	.98	.99
EPMLE .25	.78	.89	.93	.96	.85	.93	.97	.98	.92	.97	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.55	.74	.78	.85	.59	.78	.81	.89	.72	.83	.89	.92
NORMMLE	.55	.55	.53	.57	.59	.62	.63	.60	.72	.69	.72	.70
TMLE 1DF	.71	.81	.86	.90	.78	.86	.91	.95	.86	.91	.96	.98
TMLE 3DF	.70	.81	.86	.89	.77	.85	.91	.94	.86	.90	.97	.98
TMLE 10DF	.67	.78	.83	.87	.74	.83	.89	.93	.85	.89	.96	.97
EPMLE .1	.69	.77	.85	.87	.75	.84	.88	.93	.86	.90	.95	.97
EPMLE .25	.70	.78	.85	.87	.76	.84	.88	.94	.86	.90	.95	.97

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0.
3. RADAR NUMBER 3 WAS ALWAYS SENDING
4. DIAGONAL PATTERN
5. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 19

P_H SCALE 0.5, ASSUMED RHO OF -.5, PATTERN 1, RADAR 3

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.89	.92	.97	.97	.96	.96	.99	.99	.99	.99	1	1
NORMMLE	.89	.95	.98	.99	.96	.98	.99	1	.99	1	1	1
TMLE 1DF	.87	.93	.96	.98	.95	.98	.99	1	.99	1	1	1
TMLE 3DF	.88	.94	.97	.98	.95	.98	.99	1	.99	1	1	1
TMLE 10DF	.90	.95	.97	.99	.96	.98	.99	1	.99	1	1	1
EPMLE .1	.86	.92	.96	.98	.95	.98	.99	1	.99	1	1	1
EPMLE .25	.86	.92	.96	.98	.94	.97	.99	1	.99	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.77	.88	.93	.94	.82	.92	.95	.97	.85	.96	.97	.99
NORMMLE	.77	.78	.77	.76	.82	.80	.79	.77	.85	.81	.79	.78
TMLE 1DF	.85	.92	.96	.97	.91	.96	.98	.99	.97	.99	1	1
TMLE 3DF	.86	.92	.96	.97	.92	.96	.99	.99	.96	.99	1	1
TMLE 10DF	.85	.92	.96	.97	.91	.96	.98	.99	.96	.99	1	1
EPMLE .1	.84	.91	.95	.97	.92	.96	.98	.99	.97	.99	1	1
EPMLE .25	.84	.91	.95	.96	.91	.96	.98	.99	.97	.99	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.59	.79	.83	.91	.64	.83	.84	.92	.65	.88	.86	.93
NORMMLE	.59	.58	.57	.55	.64	.59	.59	.58	.65	.61	.58	.59
TMLE 1DF	.78	.85	.90	.95	.84	.92	.95	.98	.91	.97	.98	.99
TMLE 3DF	.79	.85	.91	.95	.84	.92	.95	.98	.90	.96	.98	.99
TMLE 10DF	.79	.85	.90	.95	.83	.90	.94	.97	.88	.94	.97	.98
EPMLE .1	.79	.86	.90	.95	.84	.93	.96	.98	.91	.97	.99	.99
EPMLE .25	.78	.85	.90	.95	.84	.93	.96	.98	.91	.97	.99	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.55	.73	.78	.85	.59	.78	.83	.89	.72	.86	.88	.92
NORMMLE	.55	.55	.57	.54	.59	.59	.62	.61	.72	.71	.71	.70
TMLE 1DF	.70	.79	.84	.89	.77	.86	.91	.94	.86	.93	.95	.98
TMLE 3DF	.70	.79	.85	.88	.76	.86	.90	.94	.86	.93	.95	.98
TMLE 10DF	.68	.77	.85	.87	.73	.84	.90	.93	.84	.92	.96	.98
EPMLE .1	.69	.77	.82	.86	.76	.84	.89	.94	.85	.92	.95	.98
EPMLE .25	.69	.76	.82	.86	.75	.84	.89	.93	.84	.91	.95	.97

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
3. RADAR NUMBER 3 WAS ALWAYS SENDING
4. DIAGONAL PATTERN
5. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 20

P_H SCALE 0.5, ASSUMED RHO OF .5, LINE PATTERN RADAR 5

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.95	.96	.99	.99	.99	.98	1	.99	1	.99	1	1
NORMMLE	.95	.97	.99	1	.99	.99	1	1	1	1	1	1
TMLE 1DF	.94	.97	.99	.99	.98	.99	1	1	1	1	1	1
TMLE 3DF	.94	.97	.99	.99	.98	.99	1	1	1	1	1	1
TMLE 10DF	.95	.97	.99	.99	.99	.99	1	1	1	1	1	1
EPMLE .1	.95	.97	.99	.99	.99	.99	1	1	1	1	1	1
EPMLE .25	.95	.97	.99	.99	.98	.99	1	1	.99	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.88	.95	.97	.98	.91	.95	.97	.99	.92	.98	.98	.99
NORMMLE	.88	.90	.90	.90	.91	.89	.88	.88	.92	.91	.90	.90
TMLE 1DF	.91	.96	.97	.99	.96	.97	.99	1	.98	1	1	1
TMLE 3DF	.92	.96	.98	.99	.95	.97	.99	1	.98	1	1	1
TMLE 10DF	.92	.96	.98	.99	.95	.97	.99	.99	.97	.99	.99	1
EPMLE .1	.92	.97	.98	.99	.96	.98	.99	1	.98	1	1	1
EPMLE .25	.92	.97	.98	.99	.96	.98	.99	1	.98	1	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.80	.89	.91	.94	.80	.92	.92	.96	.83	.93	.94	.96
NORMMLE	.80	.79	.80	.77	.80	.80	.78	.78	.83	.80	.79	.78
TMLE 1DF	.88	.92	.96	.97	.91	.95	.97	.99	.95	.97	.99	.99
TMLE 3DF	.88	.93	.96	.98	.92	.95	.97	.99	.95	.97	.99	.99
TMLE 10DF	.87	.92	.95	.97	.90	.94	.96	.98	.94	.96	.98	.98
EPMLE .1	.88	.93	.97	.97	.92	.95	.97	.99	.95	.97	.99	.99
EPMLE .25	.88	.93	.97	.98	.92	.95	.98	.99	.95	.98	.99	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.77	.88	.90	.92	.81	.89	.90	.94	.85	.93	.94	.96
NORMMLE	.77	.77	.79	.77	.81	.80	.80	.79	.85	.87	.85	.87
TMLE 1DF	.85	.90	.93	.95	.88	.93	.95	.97	.93	.96	.97	.99
TMLE 3DF	.84	.90	.93	.95	.88	.93	.95	.97	.93	.96	.97	.99
TMLE 10DF	.83	.89	.92	.94	.87	.92	.94	.96	.93	.96	.97	.98
EPMLE .1	.83	.88	.91	.94	.87	.91	.94	.96	.92	.95	.96	.98
EPMLE .25	.84	.88	.91	.94	.87	.91	.94	.96	.92	.95	.96	.98

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
3. RADAR NUMBER 5 WAS ALWAYS SENDING
4. DIAGONAL PATTERN
5. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 21

P_H SCALE 0.5, ASSUMED RHO OF 0, LINE PATTERN, RADAR 5

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.95	.96	.99	.99	.98	.98	.99	.99	1	.99	1	1
NORMMLE	.95	.98	.99	.99	.98	.99	1	1	1	1	1	1
TMLE 1DF	.94	.97	.99	.99	.98	.99	.99	1	1	1	1	1
TMLE 3DF	.95	.97	.99	.99	.98	.99	.99	1	1	1	1	1
TMLE 10DF	.95	.98	.99	.99	.98	.99	1	1	1	1	1	1
EPMLE .1	.95	.98	.99	.99	.98	.99	1	1	1	1	1	1
EPMLE .25	.94	.97	.99	.99	.98	.99	1	1	1	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.88	.94	.96	.97	.91	.96	.97	.99	.93	.98	.98	.99
NORMMLE	.88	.90	.88	.90	.91	.90	.89	.91	.93	.91	.90	.89
TMLE 1DF	.92	.96	.98	.98	.96	.98	.99	1	.98	1	1	1
TMLE 3DF	.93	.96	.98	.99	.96	.98	.99	1	.98	.99	1	1
TMLE 10DF	.93	.96	.98	.98	.95	.98	.99	1	.97	.99	1	1
EPMLE .1	.93	.96	.98	.99	.96	.99	.99	1	.98	1	1	1
EPMLE .25	.93	.96	.98	.99	.96	.99	.99	1	.98	1	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.79	.90	.90	.95	.82	.92	.92	.96	.83	.93	.92	.97
NORMMLE	.79	.79	.77	.79	.82	.81	.79	.78	.83	.80	.79	.80
TMLE 1DF	.88	.94	.95	.97	.92	.96	.98	.99	.94	.98	.98	.99
TMLE 3DF	.89	.94	.96	.97	.92	.96	.97	.99	.94	.97	.98	.99
TMLE 10DF	.88	.93	.94	.97	.90	.95	.96	.98	.92	.96	.97	.99
EPMLE .1	.89	.94	.96	.98	.91	.96	.98	.99	.95	.98	.99	1
EPMLE .25	.89	.94	.96	.98	.91	.96	.98	.99	.95	.98	.99	1
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.77	.87	.88	.92	.82	.89	.90	.94	.86	.93	.94	.97
NORMMLE	.77	.78	.78	.77	.82	.80	.79	.80	.86	.84	.84	.85
TMLE 1DF	.83	.89	.93	.95	.88	.93	.95	.97	.93	.95	.98	1
TMLE 3DF	.83	.89	.93	.94	.88	.92	.95	.97	.94	.95	.98	1
TMLE 10DF	.82	.88	.91	.94	.87	.91	.94	.96	.93	.95	.98	.99
EPMLE .1	.82	.87	.91	.94	.86	.91	.94	.96	.93	.95	.97	.99
EPMLE .25	.82	.87	.91	.93	.86	.91	.94	.96	.93	.94	.97	.99

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0.
3. RADAR NUMBER 5 WAS ALWAYS SENDING
4. DIAGONAL PATTERN
5. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 22

P_H SCALE 0.5, ASSUMED RHO OF -.5, PATTERN 1, RADAR 5

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.94	.95	.98	.99	.98	.98	1	.99	1	1	1	1
NORMMLE	.94	.98	.99	.99	.98	.99	1	1	1	1	1	1
TMLE 1DF	.93	.97	.98	.99	.98	.99	1	1	1	1	1	1
TMLE 3DF	.94	.97	.98	1	.98	.99	1	1	1	1	1	1
TMLE 10DF	.94	.97	.99	.99	.98	.99	1	1	1	1	1	1
EPMLE .1	.92	.96	.97	.99	.97	.99	1	1	1	1	1	1
EPMLE .25	.91	.96	.97	.99	.97	.99	.99	1	1	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.89	.94	.97	.98	.88	.97	.97	.98	.92	.98	.99	.99
NORMMLE	.89	.89	.90	.90	.88	.91	.89	.89	.92	.91	.89	.91
TMLE 1DF	.92	.96	.98	.98	.94	.98	.99	.99	.99	.99	1	1
TMLE 3DF	.93	.96	.98	.98	.94	.98	.99	1	.99	.99	1	1
TMLE 10DF	.93	.96	.98	.98	.94	.98	.99	.99	.98	.99	1	1
EPMLE .1	.92	.95	.97	.98	.94	.98	.99	1	.99	.99	1	1
EPMLE .25	.91	.95	.97	.98	.94	.98	.99	1	.99	.99	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.81	.90	.91	.94	.82	.92	.93	.97	.83	.93	.93	.97
NORMMLE	.81	.79	.77	.79	.82	.80	.78	.80	.83	.80	.78	.80
TMLE 1DF	.88	.92	.96	.97	.90	.96	.97	.99	.95	.98	.99	1
TMLE 3DF	.89	.93	.96	.97	.90	.96	.98	.99	.95	.97	.99	1
TMLE 10DF	.88	.93	.95	.97	.90	.95	.97	.99	.94	.97	.99	.99
EPMLE .1	.88	.92	.96	.97	.91	.96	.98	.99	.95	.98	.99	1
EPMLE .25	.88	.91	.95	.97	.91	.96	.97	.99	.96	.98	.99	1
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.77	.89	.89	.92	.80	.89	.91	.94	.85	.92	.94	.97
NORMMLE	.77	.81	.77	.78	.80	.82	.81	.81	.85	.84	.85	.84
TMLE 1DF	.85	.90	.92	.94	.88	.92	.95	.97	.93	.96	.98	.99
TMLE 3DF	.84	.90	.92	.94	.88	.92	.95	.97	.93	.96	.98	.99
TMLE 10DF	.84	.90	.91	.94	.87	.92	.95	.97	.93	.96	.97	.99
EPMLE .1	.82	.87	.90	.92	.85	.90	.94	.96	.91	.94	.98	.99
EPMLE .25	.82	.86	.89	.92	.84	.90	.94	.96	.90	.95	.97	.99

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME AT .5 AND 5.
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
3. RADAR NUMBER 5 WAS ALWAYS SENDING
4. DIAGONAL PATTERN
5. ENTRIES ARE THE AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 23

P_H TRUE SCALES .3 AND .7, ASSUMED .5, RHO .5, LINE

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.91	.93	.97	.97	.95	.96	.99	.99	.98	.98	1	.99
NORMMLE	.91	.95	.98	.99	.95	.98	.99	1	.98	.99	1	1
TMLE 1DF	.93	.97	.99	1	.96	.99	1	1	.99	1	1	1
TMLE 3DF	.93	.97	.99	.99	.96	.99	1	1	.99	1	1	1
TMLE 10DF	.93	.96	.98	.99	.96	.99	1	1	.99	1	1	1
EPMLE .1	.91	.96	.98	.99	.96	.98	1	1	.98	1	1	1
EPMLE .25	.92	.96	.98	.99	.95	.98	1	1	.98	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.82	.90	.92	.95	.85	.92	.95	.97	.87	.94	.97	.98
NORMMLE	.82	.83	.81	.82	.85	.83	.84	.82	.87	.86	.82	.82
TMLE 1DF	.90	.95	.97	.99	.93	.97	.99	.99	.96	.99	1	1
TMLE 3DF	.90	.95	.97	.99	.93	.97	.99	.99	.96	.99	1	1
TMLE 10DF	.89	.94	.96	.98	.92	.96	.98	.99	.94	.98	.99	.99
EPMLE .1	.89	.95	.96	.99	.93	.98	.98	.99	.96	.99	.99	1
EPMLE .25	.89	.95	.96	.99	.93	.98	.98	.99	.96	.99	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.67	.81	.86	.90	.68	.86	.88	.93	.72	.87	.87	.94
NORMMLE	.67	.64	.65	.64	.68	.67	.65	.65	.72	.66	.64	.66
TMLE 1DF	.83	.91	.96	.98	.87	.94	.97	.99	.91	.95	.98	.99
TMLE 3DF	.83	.90	.95	.97	.87	.94	.96	.98	.90	.94	.97	.99
TMLE 10DF	.81	.88	.93	.96	.84	.92	.95	.97	.87	.92	.95	.97
EPMLE .1	.82	.90	.95	.97	.87	.94	.96	.98	.91	.95	.97	.99
EPMLE .25	.83	.90	.95	.97	.87	.94	.96	.98	.91	.95	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.62	.79	.81	.88	.67	.82	.84	.89	.72	.86	.87	.93
NORMMLE	.62	.64	.63	.62	.67	.67	.68	.66	.72	.72	.74	.71
TMLE 1DF	.78	.88	.92	.95	.82	.90	.94	.95	.88	.93	.96	.98
TMLE 3DF	.78	.87	.91	.95	.82	.90	.93	.95	.88	.93	.97	.98
TMLE 10DF	.75	.85	.89	.93	.80	.88	.92	.94	.87	.92	.96	.97
EPMLE .1	.74	.85	.88	.93	.80	.88	.92	.95	.86	.92	.95	.98
EPMLE .25	.75	.85	.89	.93	.81	.88	.92	.95	.86	.92	.95	.98

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3, 3 FOR THE FIRST TERM AND .7, 7 FOR THE SECOND
2. .5 AND 5 WERE USED AS THE VALUES FOR THE SCALES IN THE ALGORITHMS
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 24

P_H TRUE SCALES .3 AND .7, ASSUMED .5, RHO .0, LINE

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.91	.93	.97	.98	.95	.96	.99	.98	.98	.98	.99	1
NORMMLE	.91	.97	.98	.99	.95	.98	1	.99	.98	1	1	1
TMLE 1DF	.92	.97	.98	.99	.96	.98	1	1	.99	1	1	1
TMLE 3DF	.92	.97	.98	.99	.96	.98	1	1	.99	1	1	1
TMLE 10DF	.92	.97	.98	.99	.95	.98	1	1	.99	1	1	1
EPMLE .1	.91	.96	.98	.99	.95	.98	.99	1	.98	1	1	1
EPMLE .25	.91	.96	.98	.99	.95	.98	.99	1	.99	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.81	.91	.94	.96	.84	.93	.96	.97	.86	.95	.97	.99
NORMMLE	.81	.83	.82	.83	.84	.82	.83	.82	.86	.84	.82	.83
TMLE 1DF	.89	.95	.97	.99	.94	.97	.99	.99	.97	.99	1	1
TMLE 3DF	.89	.95	.97	.99	.93	.97	.99	.99	.96	.99	.99	1
TMLE 10DF	.88	.95	.97	.99	.92	.96	.98	.99	.95	.98	.99	1
EPMLE .1	.88	.94	.96	.99	.93	.97	.98	.99	.96	.99	1	1
EPMLE .25	.87	.94	.96	.99	.93	.97	.98	.99	.96	.99	.99	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.66	.82	.83	.91	.69	.85	.86	.92	.72	.86	.88	.94
NORMMLE	.66	.65	.61	.64	.69	.65	.64	.64	.72	.64	.65	.66
TMLE 1DF	.82	.91	.95	.97	.87	.93	.97	.98	.91	.96	.98	.99
TMLE 3DF	.82	.90	.94	.96	.87	.92	.96	.98	.90	.95	.98	.99
TMLE 10DF	.81	.88	.92	.95	.85	.90	.95	.96	.88	.93	.96	.98
EPMLE .1	.81	.90	.94	.96	.86	.93	.96	.98	.91	.96	.98	.99
EPMLE .25	.81	.90	.94	.96	.87	.93	.96	.98	.91	.96	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.62	.79	.80	.87	.66	.81	.83	.89	.74	.85	.88	.92
NORMMLE	.62	.63	.63	.64	.66	.67	.66	.67	.74	.71	.72	.72
TMLE 1DF	.79	.86	.91	.94	.81	.88	.92	.96	.87	.93	.97	.98
TMLE 3DF	.79	.85	.90	.93	.81	.87	.91	.95	.87	.93	.96	.98
TMLE 10DF	.77	.84	.88	.90	.78	.87	.89	.94	.86	.91	.95	.98
EPMLE .1	.76	.83	.88	.91	.78	.86	.90	.94	.86	.92	.96	.97
EPMLE .25	.76	.84	.88	.92	.78	.86	.91	.94	.86	.92	.96	.97

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3, 3 FOR THE FIRST TERM AND .7, 7 FOR THE SECOND
2. .5 AND 5 WERE USED AS THE VALUES FOR THE SCALES IN THE ALGORITHMS
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .0.
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 25

P_H TRUE SCALES .3 AND .7, ASSUMED .5, RHO -.5, LINE

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.92	.93	.97	.98	.95	.95	.99	.99	.98	.98	1	1
NORMMLE	.92	.95	.98	.99	.95	.98	.99	1	.98	1	1	1
TMLE 1DF	.92	.95	.98	.99	.96	.98	1	1	.98	1	1	1
TMLE 3DF	.93	.95	.98	.99	.96	.98	1	1	.98	1	1	1
TMLE 10DF	.93	.95	.97	.99	.96	.98	1	1	.98	1	1	1
EPMLE .1	.91	.94	.97	.98	.95	.97	.99	.99	.98	1	1	1
EPMLE .25	.91	.93	.96	.98	.94	.97	.99	.99	.98	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.82	.90	.93	.96	.84	.92	.95	.97	.86	.95	.97	.98
NORMMLE	.82	.82	.80	.82	.84	.83	.83	.82	.86	.83	.83	.81
TMLE 1DF	.88	.93	.96	.98	.93	.96	.99	1	.96	.99	1	1
TMLE 3DF	.89	.93	.96	.98	.93	.96	.99	1	.96	.99	1	1
TMLE 10DF	.89	.92	.96	.98	.92	.96	.98	.99	.94	.99	.99	1
EPMLE .1	.87	.92	.95	.97	.92	.95	.98	.99	.96	.99	1	1
EPMLE .25	.86	.91	.94	.97	.92	.95	.98	.99	.95	.99	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.66	.83	.84	.91	.70	.84	.87	.93	.71	.88	.88	.93
NORMMLE	.66	.65	.64	.65	.70	.66	.65	.63	.71	.68	.63	.64
TMLE 1DF	.82	.90	.94	.96	.86	.93	.97	.98	.91	.97	.98	.99
TMLE 3DF	.82	.90	.93	.96	.86	.93	.97	.98	.91	.96	.98	.99
TMLE 10DF	.80	.89	.92	.96	.85	.91	.95	.97	.89	.95	.97	.98
EPMLE .1	.80	.89	.93	.95	.85	.93	.97	.98	.91	.96	.98	.99
EPMLE .25	.80	.89	.93	.95	.85	.93	.97	.97	.91	.96	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.63	.78	.81	.88	.65	.82	.84	.90	.73	.85	.89	.92
NORMMLE	.63	.61	.62	.63	.65	.67	.66	.66	.73	.71	.74	.72
TMLE 1DF	.77	.83	.88	.92	.82	.88	.92	.95	.87	.92	.96	.98
TMLE 3DF	.78	.83	.88	.92	.81	.88	.92	.95	.87	.93	.96	.98
TMLE 10DF	.75	.81	.86	.91	.80	.86	.91	.94	.86	.91	.95	.97
EPMLE .1	.75	.81	.86	.91	.80	.85	.90	.94	.85	.92	.95	.96
EPMLE .25	.75	.81	.86	.90	.80	.85	.90	.94	.85	.91	.95	.96

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3, 3 FOR THE FIRST TERM AND .7, 7 FOR THE SECOND
2. .5 AND 5 WERE USED AS THE VALUES FOR THE SCALES IN THE ALGORITHMS
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 26

P_H TRUE AND ASSUMED SCALES OF .3 AND .7, RHO .5, LINE

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.91	.94	.97	.98	.95	.96	.99	.99	.99	.98	1	1
NORMMLE	.99	1	1	1	.98	1	1	1	.97	.99	1	1
TMLE 1DF	.98	1	1	1	.98	1	1	1	.98	1	1	1
TMLE 3DF	.98	1	1	1	.99	1	1	1	.98	1	1	1
TMLE 10DF	.99	1	1	1	.98	1	1	1	.98	1	1	1
EPMLE .1	.99	1	1	1	.98	1	1	1	.98	.99	1	1
EPMLE .25	.98	1	1	1	.98	1	1	1	.98	.99	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.81	.89	.94	.95	.84	.92	.96	.98	.87	.94	.97	.98
NORMMLE	.87	.86	.85	.86	.87	.84	.85	.84	.87	.87	.84	.84
TMLE 1DF	.96	.99	1	1	.95	.99	.99	1	.97	.99	1	1
TMLE 3DF	.96	.99	.99	1	.95	.99	.99	1	.96	.99	1	1
TMLE 10DF	.95	.98	.99	1	.94	.98	.99	1	.95	.98	.99	1
EPMLE .1	.96	.99	1	1	.95	.98	.99	1	.96	.99	1	1
EPMLE .25	.96	.99	1	1	.95	.98	.99	1	.97	.99	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.67	.81	.85	.91	.69	.85	.86	.91	.71	.88	.89	.94
NORMMLE	.71	.69	.66	.70	.74	.68	.67	.68	.73	.69	.68	.68
TMLE 1DF	.91	.96	.99	.99	.90	.96	.98	.99	.91	.95	.98	.99
TMLE 3DF	.90	.96	.99	.99	.90	.95	.98	.99	.90	.95	.98	.99
TMLE 10DF	.88	.94	.98	.99	.89	.93	.97	.98	.89	.93	.96	.98
EPMLE .1	.91	.96	.99	.99	.91	.96	.98	.99	.91	.95	.98	.99
EPMLE .25	.91	.96	.99	.99	.91	.96	.98	.99	.91	.95	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.64	.78	.80	.87	.68	.81	.84	.90	.69	.85	.89	.92
NORMMLE	.72	.71	.72	.72	.70	.72	.72	.72	.71	.70	.71	.69
TMLE 1DF	.86	.92	.95	.97	.84	.92	.95	.97	.85	.94	.97	.98
TMLE 3DF	.86	.92	.95	.97	.84	.92	.95	.97	.85	.93	.97	.98
TMLE 10DF	.85	.91	.94	.97	.82	.90	.94	.96	.84	.92	.96	.97
EPMLE .1	.85	.90	.94	.96	.84	.90	.94	.97	.85	.93	.96	.97
EPMLE .25	.85	.90	.94	.96	.83	.90	.94	.97	.85	.92	.96	.97

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3, 3 FOR THE FIRST TERM AND .7, 7 FOR THE SECOND
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
3. DIAGONAL PATTERN
4. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 27

P_H TRUE AND ASSUMED SCALES OF .3 AND .7, RHO 0,LINE

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.91	.93	.97	.98	.95	.96	.99	.99	.98	.98	1	.99
NORMMLE	.98	.99	1	1	.99	1	1	1	1	1	1	1
TMLE 1DF	.98	.99	1	1	.99	1	1	1	1	1	1	1
TMLE 3DF	.98	.99	1	1	.99	1	1	1	1	1	1	1
TMLE 10DF	.98	.99	1	1	.99	1	1	1	1	1	1	1
EPMLE .1	.98	.99	1	1	.99	1	1	1	1	1	1	1
EPMLE .25	.98	.99	1	1	.99	1	1	1	1	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.82	.89	.94	.96	.84	.92	.95	.97	.87	.94	.97	.98
NORMMLE	.87	.86	.86	.88	.89	.87	.86	.86	.89	.87	.87	.87
TMLE 1DF	.96	.98	.99	1	.97	.99	1	1	.98	1	1	1
TMLE 3DF	.96	.98	.99	1	.97	.99	1	1	.98	.99	1	1
TMLE 10DF	.95	.97	.99	1	.96	.99	.99	1	.97	.99	1	1
EPMLE .1	.96	.98	1	1	.97	.99	1	1	.98	1	1	1
EPMLE .25	.96	.98	1	1	.97	.99	1	1	.98	1	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.66	.83	.86	.91	.70	.86	.86	.92	.72	.89	.89	.93
NORMMLE	.74	.72	.71	.72	.74	.72	.70	.73	.76	.72	.71	.72
TMLE 1DF	.91	.96	.98	.99	.92	.97	.99	.99	.94	.98	.99	1
TMLE 3DF	.90	.96	.98	.99	.92	.96	.99	.99	.93	.98	.99	1
TMLE 10DF	.89	.94	.96	.98	.90	.95	.97	.99	.91	.97	.98	.99
EPMLE .1	.91	.96	.98	.99	.92	.97	.99	.99	.95	.98	.99	1
EPMLE .25	.91	.96	.98	.99	.93	.97	.99	.99	.95	.98	1	1
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.62	.77	.82	.88	.68	.83	.85	.90	.72	.86	.86	.92
NORMMLE	.70	.71	.70	.70	.76	.76	.75	.75	.78	.77	.79	.78
TMLE 1DF	.84	.90	.94	.97	.89	.94	.96	.98	.91	.96	.98	.99
TMLE 3DF	.83	.90	.94	.97	.88	.94	.96	.98	.92	.96	.98	.99
TMLE 10DF	.81	.89	.93	.96	.87	.93	.96	.97	.91	.95	.97	.99
EPMLE .1	.82	.88	.93	.96	.88	.93	.95	.97	.90	.95	.97	.99
EPMLE .25	.82	.88	.93	.96	.87	.93	.95	.97	.90	.96	.97	.99

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3, 3 FOR THE FIRST TERM AND .7, 7 FOR THE SECOND
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0.
3. DIAGONAL PATTERN
4. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 28

P_H TRUE AND ASSUMED SCALES OF (.3 ,.7), RHO -.5, LINE

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.92	.93	.97	.97	.95	.96	.98	.98	.98	.98	1	1
NORMMLE	.97	.99	1	1	.99	1	1	1	1	1	1	1
TMLE 1DF	.96	.99	1	1	.99	1	1	1	1	1	1	1
TMLE 3DF	.97	.99	1	1	.99	1	1	1	1	1	1	1
TMLE 10DF	.97	.99	1	1	.99	1	1	1	1	1	1	1
EPMLE .1	.95	.98	.99	1	.99	1	1	1	1	1	1	1
EPMLE .25	.95	.98	.99	1	.98	1	1	1	1	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.81	.90	.94	.95	.84	.92	.96	.97	.86	.96	.97	.98
NORMMLE	.87	.85	.86	.86	.88	.87	.87	.87	.89	.86	.87	.85
TMLE 1DF	.95	.97	.99	1	.97	.99	1	1	.99	1	1	1
TMLE 3DF	.94	.97	.99	1	.97	.99	1	1	.99	1	1	1
TMLE 10DF	.94	.97	.99	.99	.96	.99	.99	1	.98	.99	1	1
EPMLE .1	.93	.97	.99	.99	.97	.99	1	1	.99	1	1	1
EPMLE .25	.93	.97	.99	.99	.97	.99	.99	1	.99	1	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.64	.81	.84	.90	.70	.86	.86	.93	.70	.88	.87	.94
NORMMLE	.72	.70	.70	.71	.74	.68	.70	.70	.74	.73	.69	.73
TMLE 1DF	.88	.94	.97	.98	.92	.97	.98	.99	.93	.99	.99	1
TMLE 3DF	.88	.94	.97	.98	.92	.96	.98	.99	.93	.98	.99	.99
TMLE 10DF	.88	.93	.96	.98	.91	.95	.97	.99	.91	.98	.98	.99
EPMLE .1	.88	.94	.97	.98	.93	.97	.98	.99	.94	.99	.99	1
EPMLE .25	.88	.93	.96	.98	.93	.97	.98	.99	.94	.99	.99	1
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.64	.79	.80	.86	.67	.81	.83	.89	.73	.86	.89	.93
NORMMLE	.71	.70	.69	.70	.74	.74	.73	.74	.80	.80	.79	.80
TMLE 1DF	.83	.90	.93	.96	.87	.93	.96	.97	.91	.96	.98	.99
TMLE 3DF	.83	.90	.92	.95	.86	.93	.96	.97	.92	.96	.98	.99
TMLE 10DF	.82	.89	.91	.94	.85	.92	.95	.97	.91	.96	.98	.99
EPMLE .1	.80	.88	.90	.93	.85	.90	.94	.96	.91	.96	.97	.99
EPMLE .25	.80	.88	.90	.93	.84	.90	.94	.95	.90	.95	.97	.98

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3, 3 FOR THE FIRST TERM AND .7, 7 FOR THE SECOND
2. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
3. DIAGONAL PATTERN
4. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 29

P_H, TRUE SCALE .9, ASSUMED SCALE .5 , ASSUMED RHO 0.5

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.71	.77	.82	.84	.78	.83	.88	.88	.90	.90	.94	.95
NORMMLE	.71	.80	.84	.89	.78	.87	.91	.93	.90	.95	.97	.99
TMLE 1DF	.65	.73	.76	.83	.73	.81	.84	.88	.86	.91	.94	.96
TMLE 3DF	.68	.75	.79	.86	.75	.84	.87	.90	.88	.92	.96	.98
TMLE 10DF	.70	.78	.83	.88	.77	.86	.89	.92	.89	.94	.97	.98
EPMLE .1	.66	.74	.76	.84	.73	.80	.84	.88	.86	.90	.94	.97
EPMLE .25	.65	.72	.75	.82	.72	.79	.82	.86	.85	.89	.94	.96
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.63	.71	.77	.80	.72	.77	.83	.83	.79	.83	.90	.91
NORMMLE	.63	.69	.68	.70	.72	.72	.72	.72	.79	.77	.77	.76
TMLE 1DF	.63	.70	.76	.79	.72	.78	.82	.86	.84	.89	.91	.96
TMLE 3DF	.65	.72	.78	.82	.73	.80	.85	.88	.84	.90	.93	.97
TMLE 10DF	.66	.75	.79	.84	.75	.81	.87	.89	.85	.91	.94	.97
EPMLE .1	.63	.70	.76	.80	.71	.77	.81	.86	.82	.88	.92	.96
EPMLE .25	.62	.68	.74	.78	.70	.76	.80	.84	.81	.87	.91	.95
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.54	.66	.67	.71	.57	.69	.72	.76	.64	.77	.77	.82
NORMMLE	.54	.54	.51	.51	.57	.56	.54	.52	.64	.60	.55	.54
TMLE 1DF	.60	.68	.71	.75	.65	.76	.79	.82	.79	.85	.89	.91
TMLE 3DF	.62	.70	.73	.78	.66	.77	.80	.84	.79	.86	.90	.92
TMLE 10DF	.64	.71	.75	.79	.67	.78	.81	.85	.78	.86	.90	.93
EPMLE .1	.60	.68	.72	.77	.64	.75	.79	.82	.76	.83	.87	.91
EPMLE .25	.59	.67	.71	.75	.63	.74	.77	.81	.75	.82	.87	.90
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.48	.62	.62	.69	.56	.66	.70	.75	.62	.74	.77	.83
NORMMLE	.48	.49	.50	.48	.56	.54	.55	.54	.62	.63	.61	.64
TMLE 1DF	.58	.66	.71	.74	.66	.73	.78	.81	.73	.83	.85	.89
TMLE 3DF	.59	.67	.72	.74	.66	.72	.78	.82	.73	.82	.85	.90
TMLE 10DF	.59	.66	.71	.73	.66	.72	.77	.81	.73	.81	.86	.90
EPMLE .1	.56	.64	.68	.73	.64	.71	.73	.77	.72	.80	.83	.88
EPMLE .25	.56	.64	.68	.72	.64	.70	.72	.77	.72	.80	.83	.88

NOTE:

1. THE TRUE SCALES ARE .9 AND 9
2. THE ASSUMED SCALES ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 30

P_H, TRUE SCALE .9, ASSUMED SCALE .5, ASSUMED RHO 0.0

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.72	.73	.82	.84	.79	.81	.88	.88	.90	.90	.95	.95
NORMMLE	.72	.79	.84	.88	.79	.86	.90	.93	.90	.96	.98	.99
TMLE 1DF	.66	.72	.77	.82	.73	.81	.85	.88	.87	.93	.96	.97
TMLE 3DF	.68	.75	.79	.84	.76	.83	.87	.90	.89	.95	.97	.98
TMLE 10DF	.71	.77	.82	.87	.78	.85	.89	.92	.90	.96	.98	.99
EPMLE .1	.66	.71	.76	.80	.74	.80	.85	.88	.87	.93	.96	.98
EPMLE .25	.65	.69	.75	.78	.73	.78	.83	.87	.86	.92	.95	.97
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.63	.71	.76	.78	.70	.76	.81	.85	.80	.85	.89	.91
NORMMLE	.63	.67	.67	.69	.70	.71	.72	.74	.80	.78	.78	.76
TMLE 1DF	.62	.70	.75	.79	.72	.79	.83	.87	.86	.89	.94	.97
TMLE 3DF	.64	.72	.78	.80	.74	.80	.85	.89	.86	.91	.95	.97
TMLE 10DF	.67	.74	.79	.83	.76	.82	.86	.91	.86	.92	.96	.98
EPMLE .1	.64	.70	.73	.78	.71	.79	.82	.87	.84	.89	.94	.96
EPMLE .25	.63	.68	.72	.76	.70	.78	.81	.86	.83	.89	.93	.96
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.53	.64	.65	.72	.56	.70	.73	.77	.65	.75	.79	.83
NORMMLE	.53	.52	.51	.50	.57	.56	.54	.53	.65	.59	.56	.54
TMLE 1DF	.61	.65	.70	.74	.65	.75	.80	.84	.80	.86	.92	.94
TMLE 3DF	.62	.67	.72	.76	.66	.77	.81	.85	.80	.87	.93	.95
TMLE 10DF	.64	.69	.73	.78	.67	.77	.82	.86	.80	.86	.92	.94
EPMLE .1	.61	.66	.70	.74	.64	.75	.78	.83	.78	.87	.91	.93
EPMLE .25	.60	.64	.69	.72	.63	.74	.77	.82	.77	.85	.90	.92
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.48	.61	.64	.71	.53	.67	.70	.73	.63	.72	.78	.83
NORMMLE	.48	.48	.50	.48	.53	.55	.53	.52	.63	.61	.63	.64
TMLE 1DF	.57	.65	.71	.75	.64	.73	.78	.82	.75	.81	.87	.91
TMLE 3DF	.57	.66	.72	.75	.64	.73	.79	.83	.75	.82	.88	.91
TMLE 10DF	.57	.65	.71	.76	.63	.72	.77	.81	.75	.81	.88	.90
EPMLE .1	.55	.63	.68	.71	.62	.71	.75	.78	.73	.80	.85	.88
EPMLE .25	.56	.63	.67	.71	.62	.70	.75	.78	.73	.79	.84	.88

NOTE:

1. THE TRUE SCALE ARE .9 AND 9
2. THE ASSUMED SCALE ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0 .
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 31

$P_{H,}$ TRUE SCALE .9, ASSUMED SCALE .5, ASSUMED RHO .5

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.71	.74	.81	.81	.79	.81	.88	.88	.90	.90	.96	.94
NORMMLE	.71	.79	.83	.88	.79	.85	.92	.94	.90	.96	.98	.99
TMLE 1DF	.64	.73	.75	.79	.72	.79	.85	.90	.87	.94	.97	.98
TMLE 3DF	.65	.74	.77	.81	.74	.81	.86	.92	.88	.95	.97	.98
TMLE 10DF	.69	.76	.80	.83	.77	.83	.89	.93	.89	.96	.98	.98
EPMLE .1	.61	.67	.71	.73	.70	.76	.82	.87	.86	.93	.95	.96
EPMLE .25	.61	.67	.70	.72	.69	.74	.81	.85	.85	.92	.94	.96
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.64	.71	.78	.79	.70	.76	.83	.85	.78	.86	.89	.91
NORMMLE	.64	.68	.70	.69	.70	.72	.72	.73	.78	.81	.78	.75
TMLE 1DF	.61	.69	.75	.77	.71	.77	.83	.88	.84	.91	.95	.96
TMLE 3DF	.63	.71	.77	.79	.73	.79	.84	.90	.86	.92	.95	.97
TMLE 10DF	.66	.72	.80	.81	.75	.81	.86	.91	.86	.92	.96	.97
EPMLE .1	.60	.64	.70	.72	.69	.74	.79	.84	.82	.89	.94	.95
EPMLE .25	.59	.63	.69	.71	.68	.73	.78	.82	.81	.88	.92	.94
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.55	.62	.68	.73	.58	.67	.72	.77	.63	.75	.79	.82
NORMMLE	.55	.52	.53	.51	.58	.54	.56	.52	.63	.59	.56	.53
TMLE 1DF	.59	.62	.70	.73	.67	.72	.79	.82	.80	.88	.92	.95
TMLE 3DF	.60	.64	.71	.75	.68	.73	.80	.84	.80	.88	.93	.95
TMLE 10DF	.61	.66	.73	.77	.69	.75	.81	.85	.81	.88	.93	.96
EPMLE .1	.57	.60	.66	.68	.65	.68	.75	.78	.78	.85	.90	.92
EPMLE .25	.56	.59	.64	.68	.63	.68	.73	.77	.77	.83	.88	.91
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.48	.62	.65	.71	.56	.68	.67	.75	.64	.74	.77	.79
NORMMLE	.48	.50	.50	.50	.56	.54	.54	.53	.64	.63	.64	.60
TMLE 1DF	.59	.65	.69	.75	.67	.72	.76	.81	.76	.84	.87	.91
TMLE 3DF	.59	.66	.70	.75	.67	.72	.77	.81	.77	.84	.88	.91
TMLE 10DF	.59	.66	.70	.74	.66	.72	.76	.81	.76	.82	.88	.90
EPMLE .1	.56	.61	.65	.71	.63	.69	.73	.77	.73	.80	.85	.88
EPMLE .25	.56	.61	.64	.70	.63	.69	.73	.76	.73	.79	.84	.87

NOTE:

1. THE TRUE SCALES ARE .9 AND 9
2. THE ASSUMED SCALES ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 53

P_H, TRUE AND ASSUMED SCALE .9, ASSUMED RHO 0.5

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.77	.81	.88	.88	.76	.80	.87	.88	.79	.79	.88	.87
NORMMLE	.78	.87	.91	.93	.75	.84	.89	.93	.74	.82	.87	.90
TMLE 1DF	.76	.85	.89	.91	.72	.80	.86	.90	.70	.78	.83	.88
TMLE 3DF	.77	.86	.91	.92	.74	.82	.87	.92	.73	.80	.86	.89
TMLE 10DF	.78	.87	.91	.93	.75	.84	.89	.92	.75	.81	.87	.90
EPMLE .1	.78	.87	.91	.93	.74	.83	.89	.92	.72	.79	.85	.88
EPMLE .25	.78	.87	.91	.93	.74	.83	.88	.92	.72	.79	.84	.87
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.75	.81	.84	.67	.75	.83	.84	.68	.75	.83	.83
NORMMLE	.70	.71	.70	.72	.65	.70	.72	.70	.63	.69	.70	.68
TMLE 1DF	.75	.81	.86	.89	.68	.78	.85	.88	.67	.77	.83	.85
TMLE 3DF	.76	.82	.87	.90	.70	.79	.87	.89	.69	.79	.84	.86
TMLE 10DF	.76	.82	.87	.90	.70	.79	.87	.89	.68	.78	.84	.86
EPMLE .1	.77	.84	.88	.91	.70	.80	.87	.90	.67	.79	.83	.85
EPMLE .25	.77	.84	.87	.91	.70	.79	.87	.89	.67	.78	.83	.84
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.54	.67	.72	.77	.56	.67	.71	.75	.56	.68	.72	.77
NORMMLE	.55	.54	.50	.50	.54	.52	.49	.48	.53	.52	.49	.49
TMLE 1DF	.69	.77	.82	.86	.65	.72	.77	.82	.62	.71	.76	.81
TMLE 3DF	.69	.78	.83	.87	.66	.73	.78	.83	.64	.71	.77	.82
TMLE 10DF	.67	.75	.81	.86	.65	.70	.77	.82	.61	.70	.74	.81
EPMLE .1	.69	.79	.84	.89	.66	.74	.80	.84	.63	.71	.77	.82
EPMLE .25	.69	.79	.85	.89	.66	.73	.80	.83	.63	.71	.76	.82
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.52	.65	.67	.74	.53	.65	.70	.75	.52	.65	.68	.75
NORMMLE	.54	.53	.53	.54	.51	.50	.51	.52	.48	.47	.47	.49
TMLE 1DF	.65	.71	.78	.83	.61	.69	.76	.80	.61	.66	.74	.78
TMLE 3DF	.64	.70	.77	.82	.61	.69	.76	.79	.59	.66	.73	.77
TMLE 10DF	.61	.68	.73	.78	.59	.66	.73	.77	.56	.64	.69	.76
EPMLE .1	.63	.69	.75	.78	.60	.66	.72	.75	.57	.64	.70	.74
EPMLE .25	.63	.69	.75	.79	.60	.67	.73	.76	.57	.64	.71	.75

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALES ARE .9 AND 9
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 33

P_H, TRUE AND ASSUMED SCALE .9, ASSUMED RHO 0.0

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.71	.73	.83	.83	.79	.81	.88	.89	.91	.89	.96	.94
NORMMLE	.71	.78	.85	.87	.79	.85	.91	.94	.91	.95	.98	.99
TMLE 1DF	.67	.74	.81	.84	.74	.83	.88	.92	.89	.94	.97	.98
TMLE 3DF	.69	.76	.84	.86	.77	.85	.90	.93	.90	.95	.98	.99
TMLE 10DF	.71	.77	.85	.87	.78	.85	.91	.94	.90	.95	.98	.99
EPMLE .1	.70	.77	.85	.87	.79	.85	.91	.94	.91	.95	.98	.99
EPMLE .25	.70	.77	.85	.87	.79	.85	.91	.94	.90	.95	.98	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.64	.71	.78	.78	.69	.77	.84	.84	.80	.84	.89	.91
NORMMLE	.64	.68	.68	.68	.69	.72	.73	.72	.80	.78	.77	.75
TMLE 1DF	.66	.72	.77	.81	.73	.80	.85	.89	.87	.91	.95	.97
TMLE 3DF	.68	.74	.79	.84	.74	.81	.87	.90	.88	.91	.96	.97
TMLE 10DF	.68	.75	.79	.84	.74	.82	.87	.90	.86	.91	.94	.97
EPMLE .1	.68	.76	.81	.86	.75	.83	.88	.91	.89	.92	.96	.98
EPMLE .25	.68	.76	.80	.86	.75	.83	.88	.91	.89	.92	.96	.98
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.52	.63	.67	.73	.58	.70	.74	.79	.64	.75	.77	.83
NORMMLE	.52	.54	.51	.52	.58	.57	.54	.53	.64	.60	.58	.55
TMLE 1DF	.60	.66	.73	.77	.69	.78	.81	.86	.80	.87	.91	.94
TMLE 3DF	.62	.68	.75	.78	.70	.80	.83	.86	.79	.87	.91	.95
TMLE 10DF	.61	.69	.74	.78	.68	.77	.81	.84	.76	.83	.88	.92
EPMLE .1	.63	.70	.76	.80	.71	.81	.84	.88	.81	.89	.92	.96
EPMLE .25	.63	.70	.76	.80	.71	.81	.84	.88	.81	.89	.93	.96
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.48	.64	.64	.71	.54	.66	.66	.75	.60	.72	.77	.81
NORMMLE	.48	.51	.48	.50	.54	.55	.52	.54	.60	.62	.63	.63
TMLE 1DF	.59	.68	.72	.75	.67	.71	.78	.83	.75	.82	.87	.90
TMLE 3DF	.58	.67	.71	.75	.66	.69	.76	.82	.74	.82	.86	.90
TMLE 10DF	.55	.65	.69	.73	.63	.67	.73	.79	.72	.79	.84	.87
EPMLE .1	.58	.64	.68	.71	.63	.67	.74	.78	.72	.79	.84	.88
EPMLE .25	.58	.64	.68	.72	.64	.67	.74	.79	.72	.80	.85	.88

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALE ARE .9 AND 9
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0 .
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 34

$P_{H,}$ TRUE AND ASSUMED SCALES .9, ASSUMED RHO .5

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.75	.82	.83	.79	.81	.88	.88	.92	.90	.95	.95
NORMMLE	.69	.78	.84	.87	.79	.87	.90	.93	.92	.95	.98	.99
TMLE 1DF	.63	.73	.76	.82	.75	.83	.87	.90	.90	.94	.97	.98
TMLE 3DF	.66	.76	.80	.85	.77	.85	.89	.91	.91	.95	.97	.98
TMLE 10DF	.68	.77	.83	.87	.79	.87	.90	.93	.92	.95	.97	.99
EPMLE .1	.66	.76	.80	.84	.78	.86	.89	.92	.92	.95	.98	.99
EPMLE .25	.65	.75	.79	.83	.78	.85	.89	.92	.91	.94	.97	.98
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.63	.70	.76	.81	.68	.76	.82	.85	.79	.83	.90	.92
NORMMLE	.63	.66	.68	.69	.68	.71	.74	.73	.79	.79	.77	.77
TMLE 1DF	.63	.70	.75	.80	.71	.79	.83	.87	.86	.91	.95	.98
TMLE 3DF	.66	.71	.78	.83	.73	.81	.85	.89	.86	.92	.96	.98
TMLE 10DF	.67	.73	.79	.84	.74	.82	.87	.89	.86	.91	.96	.98
EPMLE .1	.66	.72	.78	.82	.74	.82	.86	.89	.87	.92	.97	.99
EPMLE .25	.66	.71	.77	.81	.74	.81	.86	.89	.87	.92	.96	.99
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.53	.64	.68	.74	.58	.68	.70	.77	.65	.75	.78	.82
NORMMLE	.53	.51	.54	.51	.58	.55	.53	.55	.65	.59	.58	.55
TMLE 1DF	.61	.68	.73	.77	.68	.75	.80	.86	.80	.87	.92	.94
TMLE 3DF	.62	.68	.74	.79	.69	.76	.81	.87	.80	.87	.93	.94
TMLE 10DF	.62	.69	.75	.79	.68	.76	.82	.87	.79	.84	.91	.93
EPMLE .1	.62	.69	.74	.80	.70	.78	.82	.87	.82	.88	.94	.95
EPMLE .25	.62	.68	.73	.79	.70	.77	.82	.87	.82	.88	.94	.96
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.47	.62	.63	.69	.54	.66	.69	.76	.61	.74	.76	.82
NORMMLE	.47	.48	.47	.48	.54	.55	.55	.54	.61	.64	.64	.63
TMLE 1DF	.60	.65	.70	.74	.64	.72	.78	.82	.73	.82	.87	.91
TMLE 3DF	.60	.65	.70	.75	.64	.73	.78	.82	.73	.82	.87	.90
TMLE 10DF	.56	.64	.69	.74	.62	.70	.77	.80	.71	.80	.85	.89
EPMLE .1	.59	.63	.68	.72	.63	.69	.76	.79	.71	.79	.84	.89
EPMLE .25	.59	.63	.68	.72	.63	.69	.76	.79	.72	.80	.85	.89

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALES ARE .9 AND 9
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. DIAGONAL PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 35

P_H SCALE .5, ASSUMED RHO 0.5, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.96	.97	.98	.99	.97	.97	.99	.99	.96	.96	.99	.99
NORMMLE	.96	.98	.99	1	.96	.99	1	1	.94	.98	.99	1
TMLE 1DF	.96	.98	.99	.99	.96	.98	.99	1	.93	.97	.98	1
TMLE 3DF	.96	.98	.99	.99	.96	.98	.99	1	.94	.97	.99	1
TMLE 10DF	.96	.98	.99	1	.96	.99	1	1	.95	.98	.99	1
EPMLE .1	.96	.98	.99	1	.96	.98	1	1	.93	.96	.98	.99
EPMLE .25	.96	.98	.99	1	.95	.98	.99	1	.92	.96	.98	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.83	.93	.96	.98	.84	.94	.96	.98	.84	.93	.96	.97
NORMMLE	.83	.81	.82	.79	.84	.83	.81	.82	.83	.81	.82	.79
TMLE 1DF	.92	.96	.98	.99	.92	.97	.99	1	.90	.95	.97	.98
TMLE 3DF	.92	.97	.98	.99	.93	.97	.99	.99	.90	.95	.98	.98
TMLE 10DF	.90	.96	.98	.99	.91	.97	.98	.99	.90	.94	.98	.98
EPMLE .1	.93	.97	.99	.99	.93	.97	.99	.99	.90	.94	.97	.98
EPMLE .25	.93	.97	.98	.99	.93	.97	.99	.99	.90	.94	.97	.98
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.70	.87	.87	.92	.70	.85	.88	.93	.71	.87	.87	.93
NORMMLE	.69	.63	.63	.61	.69	.64	.62	.62	.70	.64	.60	.61
TMLE 1DF	.87	.93	.96	.98	.87	.93	.96	.97	.84	.91	.94	.97
TMLE 3DF	.87	.93	.96	.97	.87	.93	.95	.97	.84	.91	.94	.97
TMLE 10DF	.85	.91	.95	.96	.85	.90	.94	.96	.83	.90	.93	.95
EPMLE .1	.88	.94	.96	.98	.87	.93	.96	.98	.84	.91	.94	.97
EPMLE .25	.88	.94	.97	.98	.87	.93	.96	.98	.84	.90	.94	.97
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.66	.83	.86	.91	.67	.83	.86	.91	.66	.83	.85	.91
NORMMLE	.67	.71	.69	.69	.66	.67	.66	.66	.63	.63	.63	.63
TMLE 1DF	.81	.88	.92	.95	.80	.87	.92	.95	.77	.86	.90	.93
TMLE 3DF	.81	.88	.93	.95	.80	.87	.92	.95	.77	.85	.90	.92
TMLE 10DF	.79	.87	.92	.94	.77	.86	.90	.94	.75	.84	.89	.91
EPMLE .1	.79	.87	.91	.94	.78	.85	.90	.93	.76	.85	.88	.91
EPMLE .25	.80	.87	.91	.94	.79	.85	.90	.93	.75	.84	.88	.91

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALE ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 36

P_H SCALE .5, ASSUMED RHO 0.0, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.96	.97	.99	.99	.96	.98	.99	.99	.96	.97	.99	.99
NORMMLE	.96	.99	.99	1	.96	.99	1	1	.96	.99	.99	1
TMLE 1DF	.95	.98	.99	1	.95	.98	.99	1	.95	.98	.99	1
TMLE 3DF	.96	.98	.99	1	.96	.99	1	1	.95	.98	.99	1
TMLE 10DF	.96	.99	.99	1	.96	.99	1	1	.95	.99	.99	1
EPMLE .1	.96	.99	.99	1	.95	.99	1	1	.95	.98	.99	1
EPMLE .25	.96	.99	.99	1	.95	.99	1	1	.95	.98	.99	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.84	.93	.96	.97	.84	.93	.96	.98	.84	.93	.96	.98
NORMMLE	.84	.82	.83	.82	.84	.83	.82	.83	.84	.82	.81	.81
TMLE 1DF	.93	.96	.98	.99	.92	.97	.99	1	.92	.96	.98	.99
TMLE 3DF	.93	.96	.99	.99	.92	.97	.99	1	.92	.96	.98	.99
TMLE 10DF	.91	.95	.98	.98	.91	.96	.98	.99	.91	.96	.98	.99
EPMLE .1	.93	.96	.98	.99	.92	.97	.99	1	.93	.97	.98	.99
EPMLE .25	.93	.96	.98	.99	.92	.97	.99	1	.92	.97	.98	.99
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.71	.85	.88	.93	.70	.86	.87	.94	.68	.86	.87	.94
NORMMLE	.71	.66	.62	.62	.70	.63	.65	.65	.68	.65	.62	.64
TMLE 1DF	.87	.91	.95	.98	.88	.92	.96	.98	.85	.92	.96	.97
TMLE 3DF	.87	.90	.95	.97	.88	.92	.96	.98	.85	.92	.95	.97
TMLE 10DF	.85	.88	.94	.96	.85	.90	.94	.97	.83	.90	.94	.96
EPMLE .1	.87	.92	.95	.98	.89	.93	.97	.99	.86	.93	.96	.98
EPMLE .25	.87	.92	.95	.98	.89	.93	.97	.99	.86	.93	.96	.98
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.84	.85	.91	.67	.82	.86	.91	.67	.83	.86	.91
NORMMLE	.68	.69	.66	.65	.67	.67	.68	.67	.67	.66	.68	.66
TMLE 1DF	.81	.87	.92	.95	.80	.87	.93	.95	.82	.87	.92	.95
TMLE 3DF	.80	.87	.92	.95	.79	.87	.92	.95	.81	.87	.92	.94
TMLE 10DF	.77	.87	.90	.94	.77	.86	.91	.94	.79	.86	.91	.93
EPMLE .1	.79	.87	.90	.94	.79	.85	.91	.94	.80	.86	.91	.93
EPMLE .25	.79	.86	.91	.94	.79	.86	.92	.94	.80	.86	.91	.94

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALE ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0 .
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 37

P_H SCALE .5, ASSUMED RHO -.5, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.96	.96	.99	.99	.96	.97	.99	.99	.96	.97	.99	.99
NORMMLE	.95	.97	.99	1	.96	.99	1	1	.96	.98	.99	.99
TMLE 1DF	.94	.97	.99	.99	.95	.98	.99	1	.95	.98	.99	.99
TMLE 3DF	.94	.97	.99	1	.96	.98	1	1	.95	.98	.99	.99
TMLE 10DF	.95	.98	.99	1	.96	.99	1	1	.96	.98	.99	.99
EPMLE .1	.93	.96	.99	.99	.96	.98	.99	1	.96	.98	.99	.99
EPMLE .25	.93	.96	.98	.99	.95	.98	.99	.99	.96	.98	.99	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.84	.93	.97	.97	.83	.93	.96	.98	.85	.94	.96	.97
NORMMLE	.83	.81	.83	.82	.83	.83	.81	.82	.84	.82	.81	.80
TMLE 1DF	.90	.95	.98	.98	.91	.96	.98	1	.93	.96	.98	.99
TMLE 3DF	.90	.95	.98	.98	.92	.97	.98	1	.93	.96	.98	.99
TMLE 10DF	.89	.95	.98	.99	.91	.96	.98	.99	.92	.96	.98	.99
EPMLE .1	.90	.94	.97	.98	.92	.97	.98	1	.93	.97	.98	.99
EPMLE .25	.89	.94	.97	.98	.92	.97	.99	1	.93	.96	.98	.99
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.88	.88	.94	.67	.87	.87	.94	.68	.85	.87	.93
NORMMLE	.67	.65	.61	.62	.67	.64	.61	.61	.67	.63	.61	.62
TMLE 1DF	.84	.92	.95	.98	.85	.93	.96	.98	.86	.91	.96	.97
TMLE 3DF	.84	.91	.94	.98	.84	.93	.96	.97	.87	.92	.96	.97
TMLE 10DF	.82	.90	.93	.97	.82	.90	.94	.96	.84	.90	.94	.96
EPMLE .1	.84	.92	.94	.98	.85	.94	.96	.98	.87	.94	.97	.98
EPMLE .25	.84	.92	.94	.98	.85	.93	.96	.98	.87	.94	.97	.98
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.67	.82	.85	.90	.67	.82	.86	.91	.67	.81	.85	.90
NORMMLE	.63	.65	.64	.64	.65	.65	.66	.68	.70	.69	.69	.69
TMLE 1DF	.79	.85	.91	.93	.78	.87	.93	.94	.81	.88	.93	.95
TMLE 3DF	.79	.85	.91	.93	.77	.87	.93	.94	.81	.88	.92	.95
TMLE 10DF	.77	.84	.89	.91	.76	.85	.91	.94	.80	.86	.91	.94
EPMLE .1	.77	.84	.88	.92	.77	.85	.91	.93	.80	.86	.92	.93
EPMLE .25	.77	.83	.89	.91	.77	.85	.91	.93	.80	.86	.92	.93

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALE ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 38

P_H SCALE .5, ASSUMED RHO 0.5, RADAR 3, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.89	.92	.97	.98	.92	.92	.98	.98	.89	.91	.97	.98
NORMMLE	.89	.96	.98	.99	.92	.97	.99	1	.89	.95	.97	.99
TMLE 1DF	.87	.94	.97	.98	.89	.96	.98	.99	.85	.93	.96	.99
TMLE 3DF	.89	.95	.97	.99	.91	.96	.99	1	.87	.93	.97	.99
TMLE 10DF	.89	.95	.98	.99	.92	.97	.99	1	.88	.95	.97	.99
EPMLE .1	.89	.96	.98	.99	.91	.96	.98	1	.85	.92	.96	.99
EPMLE .25	.89	.95	.98	.99	.91	.96	.99	.99	.85	.92	.95	.98
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.72	.85	.92	.95	.76	.87	.92	.95	.75	.85	.92	.95
NORMMLE	.72	.71	.71	.69	.76	.75	.70	.69	.75	.71	.71	.68
TMLE 1DF	.83	.91	.95	.98	.85	.93	.96	.98	.84	.90	.95	.97
TMLE 3DF	.83	.92	.96	.98	.85	.93	.97	.98	.84	.90	.95	.98
TMLE 10DF	.82	.90	.96	.98	.84	.92	.96	.98	.84	.89	.95	.98
EPMLE .1	.84	.93	.96	.99	.85	.94	.97	.98	.84	.89	.94	.97
EPMLE .25	.84	.93	.97	.99	.84	.94	.97	.98	.84	.89	.94	.97
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.54	.73	.78	.87	.54	.75	.77	.87	.52	.73	.78	.86
NORMMLE	.54	.44	.40	.36	.54	.47	.40	.38	.52	.44	.42	.38
TMLE 1DF	.76	.85	.90	.95	.76	.87	.92	.96	.73	.85	.90	.94
TMLE 3DF	.77	.84	.90	.95	.75	.86	.92	.96	.73	.84	.90	.93
TMLE 10DF	.73	.81	.88	.93	.72	.83	.89	.94	.70	.80	.88	.92
EPMLE .1	.79	.87	.92	.96	.77	.88	.93	.97	.74	.85	.91	.94
EPMLE .25	.79	.87	.92	.96	.77	.88	.93	.96	.74	.85	.90	.94
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.46	.67	.72	.82	.48	.69	.71	.81	.46	.68	.72	.82
NORMMLE	.46	.48	.47	.47	.48	.47	.45	.45	.46	.46	.48	.48
TMLE 1DF	.65	.77	.82	.89	.66	.76	.83	.89	.65	.75	.82	.88
TMLE 3DF	.65	.76	.82	.88	.66	.75	.83	.88	.64	.74	.82	.88
TMLE 10DF	.60	.72	.79	.86	.61	.71	.79	.86	.61	.72	.81	.86
EPMLE .1	.63	.73	.80	.87	.65	.75	.83	.86	.64	.73	.81	.86
EPMLE .25	.63	.74	.81	.87	.66	.75	.83	.86	.64	.74	.80	.86

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALE ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH
6. RADAR 3 WAS ALWAYS SENDING

TABLE 39

P_H SCALE .5, ASSUMED RHO 0.0, RADAR 3, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.90	.92	.97	.98	.91	.93	.98	.99	.90	.92	.97	.98
NORMMLE	.90	.95	.98	.99	.91	.97	.99	1	.90	.96	.98	.99
TMLE 1DF	.87	.93	.97	.98	.90	.96	.99	1	.88	.94	.97	.99
TMLE 3DF	.88	.94	.97	.99	.91	.97	.99	1	.90	.95	.98	.99
TMLE 10DF	.89	.95	.98	.99	.91	.97	.99	1	.90	.96	.98	.99
EPMLE .1	.89	.94	.98	.99	.91	.97	.99	1	.90	.96	.98	.99
EPMLE .25	.89	.94	.98	.99	.90	.97	.99	1	.90	.96	.98	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.73	.86	.91	.94	.74	.87	.92	.95	.73	.85	.92	.94
NORMMLE	.73	.72	.69	.69	.74	.75	.70	.69	.73	.71	.72	.68
TMLE 1DF	.83	.91	.95	.97	.86	.93	.97	.98	.82	.91	.95	.97
TMLE 3DF	.83	.91	.95	.98	.86	.93	.97	.99	.83	.91	.96	.97
TMLE 10DF	.81	.90	.94	.98	.83	.92	.97	.98	.81	.89	.95	.97
EPMLE .1	.84	.92	.96	.98	.87	.94	.98	.99	.84	.91	.97	.97
EPMLE .25	.84	.92	.96	.98	.87	.94	.98	.99	.84	.92	.96	.98
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.52	.74	.78	.86	.55	.73	.78	.87	.55	.74	.77	.87
NORMMLE	.52	.45	.42	.38	.55	.48	.38	.39	.55	.45	.42	.38
TMLE 1DF	.75	.85	.91	.94	.77	.86	.92	.96	.76	.85	.90	.95
TMLE 3DF	.75	.85	.91	.94	.76	.85	.91	.96	.75	.85	.90	.95
TMLE 10DF	.69	.81	.88	.91	.72	.81	.87	.93	.70	.81	.88	.93
EPMLE .1	.75	.86	.92	.95	.77	.87	.93	.97	.77	.86	.92	.95
EPMLE .25	.76	.86	.92	.95	.77	.87	.93	.97	.77	.86	.91	.96
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.47	.65	.73	.81	.46	.65	.72	.82	.49	.67	.72	.81
NORMMLE	.47	.47	.46	.46	.46	.46	.48	.46	.49	.45	.45	.46
TMLE 1DF	.66	.74	.84	.89	.65	.76	.84	.89	.66	.77	.85	.89
TMLE 3DF	.66	.73	.83	.88	.63	.75	.83	.88	.65	.75	.84	.88
TMLE 10DF	.60	.70	.81	.85	.59	.71	.80	.86	.60	.71	.80	.85
EPMLE .1	.64	.72	.82	.86	.62	.74	.82	.86	.63	.74	.83	.86
EPMLE .25	.65	.73	.82	.87	.63	.75	.83	.86	.65	.75	.84	.87

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALE ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0 .
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH
6. RADAR 3 WAS ALWAYS SENDING

TABLE 40

P_H SCALE .5, ASSUMED RHO .5, RADAR 3, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.90	.92	.97	.98	.90	.94	.98	.98	.89	.92	.96	.98
NORMMLE	.90	.95	.98	.99	.90	.98	.99	1	.89	.96	.98	.99
TMLE 1DF	.87	.94	.96	.99	.88	.96	.98	.99	.87	.95	.97	.99
TMLE 3DF	.88	.94	.97	.99	.90	.97	.99	1	.88	.95	.97	.99
TMLE 10DF	.89	.95	.98	.99	.90	.97	.99	1	.89	.96	.97	.99
EPMLE .1	.87	.93	.96	.99	.89	.97	.99	1	.89	.96	.98	.99
EPMLE .25	.86	.93	.95	.98	.88	.96	.98	.99	.89	.95	.97	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.73	.86	.92	.94	.74	.86	.92	.96	.73	.85	.91	.95
NORMMLE	.73	.71	.71	.68	.74	.73	.70	.69	.73	.72	.69	.68
TMLE 1DF	.82	.90	.95	.96	.83	.92	.97	.99	.84	.91	.95	.97
TMLE 3DF	.82	.91	.96	.97	.84	.93	.97	.99	.84	.91	.95	.97
TMLE 10DF	.81	.90	.96	.96	.83	.92	.97	.98	.83	.91	.94	.97
EPMLE .1	.83	.91	.95	.96	.84	.94	.97	.99	.85	.92	.96	.98
EPMLE .25	.82	.89	.94	.96	.84	.93	.97	.99	.85	.92	.96	.98
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.54	.72	.79	.85	.53	.76	.77	.87	.52	.75	.77	.85
NORMMLE	.54	.46	.40	.38	.53	.46	.42	.41	.52	.46	.40	.40
TMLE 1DF	.76	.82	.90	.94	.76	.85	.93	.95	.73	.85	.91	.93
TMLE 3DF	.75	.82	.90	.94	.76	.86	.92	.95	.74	.86	.91	.93
TMLE 10DF	.72	.78	.88	.91	.71	.82	.89	.94	.71	.83	.88	.92
EPMLE .1	.75	.83	.90	.94	.77	.87	.94	.96	.76	.88	.92	.95
EPMLE .25	.75	.82	.90	.93	.77	.87	.94	.96	.76	.88	.92	.95
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.47	.68	.72	.82	.47	.67	.73	.82	.48	.69	.73	.81
NORMMLE	.47	.48	.47	.46	.47	.48	.48	.46	.48	.47	.47	.48
TMLE 1DF	.65	.75	.84	.87	.66	.76	.86	.89	.67	.76	.84	.89
TMLE 3DF	.64	.74	.83	.87	.65	.75	.84	.89	.66	.76	.83	.89
TMLE 10DF	.59	.72	.80	.85	.62	.72	.81	.86	.61	.72	.80	.86
EPMLE .1	.64	.73	.81	.85	.64	.74	.82	.88	.66	.75	.81	.86
EPMLE .25	.64	.73	.81	.85	.65	.74	.83	.87	.66	.75	.82	.87

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALES ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH
6. RADAR 3 WAS ALWAYS SENDING

TABLE 41

P_H SCALE .5, ASSUMED RHO 0.5, RADAR 5, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

EPSILON=0

	RHO = .5				RHO = 0				RHO = -.5			
	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.99	.99	1	1	.97	.98	1	.99	.94	.96	.98	.99
NORMMLE	1	1	1	1	.97	.99	1	1	.94	.98	.99	1
TMLE 1DF	1	1	1	1	.97	.99	1	1	.93	.96	.98	.99
TMLE 3DF	1	1	1	1	.97	.99	1	1	.93	.97	.98	.99
TMLE 10DF	1	1	1	1	.97	.99	1	1	.94	.97	.99	1
EPMLE .1	1	1	1	1	.97	.99	1	1	.92	.96	.98	.99
EPMLE .25	1	1	1	1	.96	.99	1	1	.92	.96	.98	.99

EPSILON=.1

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.88	.97	.98	.99	.87	.95	.97	.98	.85	.94	.96	.98
NORMMLE	.91	.89	.89	.88	.90	.89	.89	.88	.87	.87	.87	.87
TMLE 1DF	.98	.99	1	1	.96	.98	.99	1	.92	.95	.98	.99
TMLE 3DF	.98	.99	1	1	.96	.98	.99	1	.92	.95	.98	.99
TMLE 10DF	.97	.99	1	1	.95	.98	.99	.99	.92	.96	.98	.99
EPMLE .1	.98	.99	1	1	.96	.98	.99	1	.91	.95	.97	.99
EPMLE .25	.98	.99	1	1	.95	.98	.99	1	.91	.95	.97	.98

EPSILON=.25

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.75	.91	.90	.96	.75	.89	.91	.94	.71	.88	.88	.94
NORMMLE	.80	.76	.74	.75	.80	.76	.75	.76	.76	.75	.77	.75
TMLE 1DF	.94	.98	.99	1	.90	.95	.97	.98	.87	.92	.96	.97
TMLE 3DF	.94	.98	.98	.99	.90	.95	.97	.98	.87	.92	.96	.97
TMLE 10DF	.92	.97	.98	.99	.90	.93	.96	.97	.87	.91	.95	.97
EPMLE .1	.95	.99	.99	1	.91	.96	.98	.98	.87	.92	.96	.97
EPMLE .25	.95	.99	.99	1	.91	.95	.98	.98	.87	.92	.95	.97

CAUCHY

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.70	.87	.89	.95	.71	.85	.89	.92	.72	.85	.87	.92
NORMMLE	.80	.80	.79	.79	.77	.77	.77	.78	.75	.75	.76	.76
TMLE 1DF	.90	.95	.97	.99	.85	.90	.94	.96	.81	.89	.91	.94
TMLE 3DF	.90	.95	.97	.99	.85	.91	.94	.96	.81	.89	.92	.95
TMLE 10DF	.89	.95	.96	.98	.84	.90	.94	.96	.81	.88	.91	.94
EPMLE .1	.89	.95	.96	.98	.84	.88	.92	.95	.80	.86	.89	.92
EPMLE .25	.89	.94	.96	.98	.83	.88	.92	.95	.79	.86	.88	.92

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALES ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH
6. RADAR 5 WAS ALWAYS SENDING

TABLE 42

P_H SCALE .5, ASSUMED RHO 0.0, RADAR 5, BOX PATTERN

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.99	.99	1	1	.97	.98	1	1	.95	.96	.98	.99
NORMMLE	.99	1	1	1	.97	.99	1	1	.95	.98	.98	.99
TMLE 1DF	.99	1	1	1	.97	.99	1	1	.94	.97	.98	.99
TMLE 3DF	.99	1	1	1	.97	.99	1	1	.94	.97	.98	1
TMLE 10DF	.99	1	1	1	.97	.99	1	1	.95	.97	.98	1
EPMLE .1	.99	1	1	1	.97	.99	1	1	.94	.97	.98	.99
EPMLE .25	.99	1	1	1	.97	.99	1	1	.94	.97	.98	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.88	.97	.98	.99	.86	.95	.97	.98	.86	.93	.96	.97
NORMMLE	.88	.86	.85	.86	.86	.86	.84	.86	.86	.84	.85	.85
TMLE 1DF	.97	.99	.99	1	.94	.98	.99	1	.92	.96	.97	.99
TMLE 3DF	.97	.99	.99	1	.94	.98	.99	1	.92	.96	.97	.99
TMLE 10DF	.95	.98	.99	1	.93	.97	.98	.99	.92	.96	.98	.99
EPMLE .1	.97	.99	1	1	.94	.98	.99	1	.92	.97	.98	.99
EPMLE .25	.97	.99	1	1	.94	.98	.99	1	.92	.96	.97	.99
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.75	.89	.91	.96	.74	.89	.90	.95	.71	.87	.89	.95
NORMMLE	.75	.70	.68	.69	.74	.69	.69	.68	.71	.69	.68	.69
TMLE 1DF	.93	.96	.99	.99	.89	.95	.97	.98	.87	.92	.95	.97
TMLE 3DF	.92	.95	.98	.99	.89	.94	.97	.98	.87	.92	.95	.97
TMLE 10DF	.89	.93	.97	.98	.87	.92	.96	.97	.85	.91	.94	.97
EPMLE .1	.93	.96	.98	.99	.90	.95	.97	.99	.88	.93	.95	.98
EPMLE .25	.93	.96	.99	.99	.90	.95	.98	.99	.88	.93	.95	.98
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.72	.87	.90	.94	.71	.87	.89	.93	.72	.86	.87	.92
NORMMLE	.72	.69	.72	.70	.71	.72	.73	.73	.72	.72	.74	.73
TMLE 1DF	.87	.92	.96	.98	.84	.91	.94	.96	.81	.88	.92	.95
TMLE 3DF	.87	.92	.96	.98	.84	.90	.94	.96	.80	.88	.92	.94
TMLE 10DF	.85	.90	.95	.97	.82	.89	.93	.96	.78	.87	.91	.94
EPMLE .1	.86	.91	.96	.97	.82	.89	.93	.95	.79	.87	.91	.93
EPMLE .25	.86	.91	.96	.97	.82	.88	.93	.95	.79	.87	.91	.93

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALES ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0 .
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH
6. RADAR 5 WAS ALWAYS SENDING

TABLE 43

P_H SCALE .5, ASSUMED RHO .5, RADAR 5, BOX PATTERN

	CORRELATION COEFFICIENT USED TO GENERATE THE ERROR											
	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.99	1	1	1	.98	.98	1	.99	.95	.96	.99	.99
NORMMLE	.96	.98	1	1	.97	.99	1	1	.95	.98	.99	.99
TMLE 1DF	.97	.99	1	1	.96	.99	1	1	.94	.97	.98	.99
TMLE 3DF	.97	.99	1	1	.96	.99	1	1	.94	.98	.99	.99
TMLE 10DF	.97	.99	1	1	.97	.99	1	1	.95	.98	.99	.99
EPMLE .1	.96	.99	1	1	.97	.99	1	1	.95	.98	.99	.99
EPMLE .25	.96	.99	.99	1	.97	.99	1	1	.95	.98	.99	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.88	.97	.98	.99	.86	.97	.97	.98	.85	.94	.95	.98
NORMMLE	.84	.80	.81	.80	.82	.81	.80	.79	.81	.80	.78	.79
TMLE 1DF	.93	.98	.99	1	.92	.97	.99	.99	.91	.96	.98	.99
TMLE 3DF	.93	.97	.99	1	.92	.98	.99	.99	.91	.96	.98	.99
TMLE 10DF	.92	.96	.98	1	.91	.97	.99	.99	.91	.96	.97	.99
EPMLE .1	.93	.98	.99	1	.92	.98	.99	.99	.92	.96	.98	.99
EPMLE .25	.93	.98	.99	1	.92	.98	.99	.99	.92	.96	.98	.99
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.73	.92	.91	.96	.73	.90	.89	.96	.72	.87	.89	.95
NORMMLE	.64	.61	.61	.60	.66	.61	.60	.62	.65	.58	.58	.60
TMLE 1DF	.87	.94	.97	.98	.86	.93	.96	.99	.86	.92	.95	.98
TMLE 3DF	.86	.94	.97	.98	.85	.93	.96	.99	.86	.91	.95	.98
TMLE 10DF	.83	.91	.95	.97	.83	.90	.94	.97	.84	.89	.94	.97
EPMLE .1	.88	.94	.98	.98	.87	.94	.96	.99	.87	.92	.96	.98
EPMLE .25	.88	.94	.98	.98	.87	.94	.96	.99	.87	.92	.97	.98
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.71	.86	.89	.94	.73	.86	.88	.93	.73	.85	.88	.91
NORMMLE	.61	.60	.60	.62	.65	.64	.63	.62	.67	.67	.69	.68
TMLE 1DF	.81	.87	.92	.95	.79	.88	.92	.96	.79	.87	.91	.94
TMLE 3DF	.81	.87	.92	.95	.79	.87	.91	.96	.79	.86	.90	.93
TMLE 10DF	.79	.85	.91	.94	.78	.86	.90	.94	.77	.85	.90	.91
EPMLE .1	.79	.86	.90	.94	.78	.86	.89	.94	.78	.85	.90	.91
EPMLE .25	.80	.86	.90	.94	.77	.86	.89	.94	.78	.85	.90	.91

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE SCALES ARE .5 AND 5
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH
6. RADAR 5 WAS ALWAYS SENDING

TABLE 44

P_H TRUE SCALE .3 AND .7, ASSUMED .5, RHO .5, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.94	.96	.98	.99	.95	.96	.99	.99	.94	.96	.98	.98
NORMMLE	.95	.98	.99	1	.95	.99	.99	1	.93	.98	.99	.99
TMLE 1DF	.95	.99	.99	1	.95	.98	.99	1	.93	.97	.99	.99
TMLE 3DF	.96	.99	.99	1	.95	.99	.99	1	.94	.97	.99	.99
TMLE 10DF	.95	.99	.99	1	.95	.99	.99	1	.94	.97	.99	.99
EPMLE .1	.94	.98	.99	1	.94	.98	.99	1	.92	.96	.98	.99
EPMLE .25	.94	.98	.99	1	.94	.98	.99	1	.91	.96	.98	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.82	.92	.96	.96	.84	.92	.95	.97	.83	.93	.96	.96
NORMMLE	.82	.82	.81	.79	.83	.82	.80	.81	.82	.82	.82	.82
TMLE 1DF	.92	.97	.98	.99	.91	.96	.98	1	.91	.95	.98	.99
TMLE 3DF	.92	.97	.98	.99	.92	.96	.98	1	.90	.95	.98	.99
TMLE 10DF	.90	.96	.98	.98	.90	.96	.97	.99	.90	.94	.98	.98
EPMLE .1	.91	.96	.98	.99	.91	.96	.98	.99	.89	.94	.97	.98
EPMLE .25	.91	.96	.98	.99	.91	.96	.98	.99	.88	.94	.97	.98
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.71	.85	.87	.92	.70	.85	.87	.92	.67	.85	.88	.91
NORMMLE	.68	.63	.61	.61	.68	.64	.61	.61	.66	.62	.63	.59
TMLE 1DF	.87	.92	.96	.98	.85	.92	.96	.97	.83	.90	.95	.96
TMLE 3DF	.86	.92	.96	.98	.85	.91	.95	.96	.82	.90	.95	.96
TMLE 10DF	.84	.89	.94	.97	.84	.89	.94	.96	.81	.87	.94	.95
EPMLE .1	.87	.92	.96	.98	.84	.92	.95	.97	.82	.89	.94	.96
EPMLE .25	.87	.92	.96	.98	.84	.92	.95	.97	.82	.89	.94	.95
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.83	.83	.90	.66	.82	.84	.91	.67	.83	.85	.90
NORMMLE	.69	.68	.67	.69	.64	.66	.66	.67	.62	.64	.64	.63
TMLE 1DF	.81	.89	.93	.95	.79	.87	.91	.94	.78	.86	.91	.93
TMLE 3DF	.81	.89	.92	.96	.79	.87	.91	.95	.78	.86	.91	.93
TMLE 10DF	.79	.87	.90	.94	.77	.85	.90	.93	.77	.84	.89	.92
EPMLE .1	.79	.87	.91	.94	.77	.84	.88	.92	.76	.84	.89	.91
EPMLE .25	.79	.87	.91	.94	.77	.84	.88	.92	.76	.84	.89	.92

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3 AND 3 FOR THE FIRST PARAMETER AND .7 AND 7 FOR THE SECOND PARAMETER.
2. THE ASSUMED VALUE FOR THE SCALE USED IN THE ALGORITHMS WAS .5 and 5.
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. BOX PATTERN

TABLE 45

P_H TRUE SCALE .3 AND .7, ASSUMED .5, RHO .0, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

EPSILON=0

	RHO = .5				RHO = 0				RHO = -.5			
	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.94	.95	.98	.99	.95	.96	.99	.99	.95	.96	.98	.99
NORMMLE	.94	.97	.99	.99	.95	.99	.99	1	.95	.98	.99	.99
TMLE 1DF	.94	.97	.99	.99	.95	.99	1	1	.95	.98	.99	.99
TMLE 3DF	.95	.97	.99	.99	.95	.99	1	1	.95	.98	.99	.99
TMLE 10DF	.94	.97	.99	.99	.95	.99	1	1	.95	.98	.99	.99
EPMLE .1	.93	.97	.99	.99	.95	.99	.99	1	.95	.98	.99	.99
EPMLE .25	.93	.97	.99	.99	.94	.98	.99	1	.94	.98	.99	.99

EPSILON=.1

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.83	.93	.96	.97	.84	.94	.96	.97	.83	.91	.96	.96
NORMMLE	.83	.83	.82	.83	.84	.85	.83	.84	.83	.83	.84	.82
TMLE 1DF	.91	.97	.98	.99	.93	.97	.99	.99	.92	.97	.98	.99
TMLE 3DF	.91	.96	.98	.99	.93	.96	.99	.99	.91	.97	.98	.98
TMLE 10DF	.90	.95	.98	.99	.92	.96	.98	.99	.89	.95	.98	.98
EPMLE .1	.91	.96	.98	.99	.92	.96	.98	.99	.91	.96	.98	.98
EPMLE .25	.91	.96	.98	.99	.92	.96	.98	.99	.91	.96	.98	.98

EPSILON=.25

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.87	.88	.92	.70	.85	.87	.93	.71	.86	.87	.93
NORMMLE	.69	.67	.65	.64	.70	.66	.64	.64	.71	.66	.66	.65
TMLE 1DF	.87	.93	.96	.97	.87	.93	.96	.98	.87	.92	.96	.98
TMLE 3DF	.86	.93	.96	.97	.86	.92	.95	.98	.87	.91	.95	.98
TMLE 10DF	.83	.91	.94	.96	.83	.89	.93	.96	.84	.89	.93	.96
EPMLE .1	.87	.92	.95	.98	.86	.92	.96	.98	.86	.91	.95	.98
EPMLE .25	.88	.92	.95	.97	.86	.92	.96	.98	.86	.92	.96	.98

CAUCHY

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.81	.84	.89	.68	.82	.85	.90	.70	.82	.84	.90
NORMMLE	.68	.67	.66	.67	.68	.66	.68	.68	.70	.67	.67	.67
TMLE 1DF	.82	.86	.91	.94	.79	.87	.92	.95	.81	.87	.92	.94
TMLE 3DF	.82	.86	.91	.94	.79	.86	.91	.95	.81	.87	.92	.94
TMLE 10DF	.79	.85	.90	.92	.77	.85	.90	.94	.79	.85	.89	.92
EPMLE .1	.80	.85	.90	.93	.77	.85	.90	.93	.79	.86	.91	.92
EPMLE .25	.81	.85	.90	.93	.78	.85	.90	.92	.79	.86	.91	.92

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3 AND 3 FOR THE FIRST PARAMETER AND .7 AND 7 FOR THE SECOND PARAMETER.
2. THE ASSUMED VALUE FOR THE SCALE USED IN THE ALGORITHMS WAS .5 AND 5.
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0.
4. BOX PATTERN

TABLE 46

P_H TRUE SCALE .3 AND .7, ASSUMED .5, RHO -.5, BOX

	CORRELATION COEFFICIENT USED TO GENERATE THE ERROR											
	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.95	.96	.99	.99	.94	.96	.98	.99	.94	.95	.98	.99
NORMMLE	.94	.97	.99	.99	.94	.98	.99	1	.95	.98	.98	1
TMLE 1DF	.93	.97	.99	.99	.94	.98	.99	1	.96	.98	.99	1
TMLE 3DF	.94	.97	.99	.99	.94	.99	.99	1	.95	.98	.99	1
TMLE 10DF	.95	.97	.99	.99	.95	.99	.99	1	.95	.98	.99	1
EPMLE .1	.92	.96	.98	.99	.93	.98	.99	1	.95	.98	.99	1
EPMLE .25	.92	.95	.98	.98	.93	.98	.99	1	.94	.97	.99	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.82	.91	.96	.96	.83	.92	.95	.97	.83	.92	.95	.97
NORMMLE	.81	.81	.80	.82	.82	.82	.81	.81	.82	.83	.80	.82
TMLE 1DF	.90	.95	.98	.99	.91	.97	.98	.99	.93	.97	.98	.99
TMLE 3DF	.90	.95	.98	.99	.90	.97	.98	.99	.93	.97	.98	.99
TMLE 10DF	.89	.94	.97	.99	.89	.96	.97	.99	.91	.96	.98	.99
EPMLE .1	.88	.94	.97	.98	.90	.96	.98	.99	.91	.96	.98	.99
EPMLE .25	.88	.93	.96	.98	.90	.96	.97	.99	.91	.96	.98	.99
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.84	.87	.93	.70	.84	.87	.92	.70	.84	.87	.91
NORMMLE	.67	.62	.63	.62	.69	.64	.62	.63	.68	.63	.62	.60
TMLE 1DF	.83	.90	.93	.96	.85	.91	.96	.98	.85	.93	.97	.98
TMLE 3DF	.83	.89	.93	.96	.85	.91	.95	.98	.86	.92	.96	.97
TMLE 10DF	.81	.87	.92	.95	.83	.89	.93	.97	.83	.89	.95	.96
EPMLE .1	.84	.89	.93	.95	.86	.91	.95	.98	.85	.92	.96	.97
EPMLE .25	.83	.89	.93	.95	.85	.91	.96	.98	.85	.92	.96	.97
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.83	.85	.90	.65	.82	.86	.90	.66	.83	.83	.90
NORMMLE	.66	.64	.63	.63	.63	.65	.67	.64	.67	.68	.68	.68
TMLE 1DF	.78	.85	.91	.94	.78	.86	.91	.94	.81	.89	.92	.96
TMLE 3DF	.79	.84	.91	.94	.78	.85	.91	.94	.80	.88	.91	.95
TMLE 10DF	.78	.84	.89	.93	.75	.85	.90	.93	.79	.86	.90	.94
EPMLE .1	.77	.83	.89	.92	.75	.84	.90	.93	.79	.87	.89	.93
EPMLE .25	.77	.83	.89	.92	.76	.84	.90	.93	.79	.87	.90	.94

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3 AND 3 FOR THE FIRST PARAMETER AND.7 AND 7 FOR THE SECOND PARAMETER.
2. THE ASSUMED VALUE FOR THE SCALE USED IN THE ALGORITHMS WAS .5 AND 5.
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0.
4. BOX PATTERN

TABLE 47

P_H TRUE AND ASSUMED SCALES .3 AND .7, RHO .5, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.94	.96	.98	.99	.95	.95	.99	.98	.94	.95	.98	.99
NORMMLE	.99	1	1	1	.96	.99	1	1	.93	.97	.98	.99
TMLE 1DF	.98	.99	1	1	.96	.99	.99	1	.93	.97	.99	1
TMLE 3DF	.99	.99	1	1	.96	.99	1	1	.94	.97	.99	1
TMLE 10DF	.99	1	1	1	.96	.99	1	1	.94	.97	.99	1
EPMLE .1	.99	1	1	1	.96	.98	1	1	.91	.96	.98	.99
EPMLE .25	.99	1	1	1	.96	.98	.99	1	.92	.96	.98	.99
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.83	.93	.96	.97	.84	.93	.95	.97	.84	.93	.95	.96
NORMMLE	.86	.85	.83	.82	.85	.84	.83	.82	.81	.82	.81	.82
TMLE 1DF	.96	.99	.99	1	.93	.97	.99	.99	.91	.97	.98	.98
TMLE 3DF	.96	.99	.99	1	.94	.97	.99	.99	.91	.96	.98	.99
TMLE 10DF	.94	.98	.99	1	.93	.96	.99	.99	.90	.95	.97	.98
EPMLE .1	.96	.99	1	1	.93	.97	.99	.99	.90	.96	.97	.98
EPMLE .25	.97	.99	1	1	.93	.97	.99	.99	.90	.96	.97	.98
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.86	.87	.93	.71	.86	.87	.93	.70	.85	.87	.93
NORMMLE	.72	.65	.62	.65	.71	.65	.64	.63	.69	.65	.63	.64
TMLE 1DF	.91	.95	.98	.99	.85	.93	.96	.99	.85	.92	.94	.97
TMLE 3DF	.91	.95	.98	.99	.86	.94	.96	.98	.85	.92	.94	.97
TMLE 10DF	.89	.93	.96	.98	.84	.92	.95	.97	.83	.90	.92	.96
EPMLE .1	.91	.96	.98	.99	.87	.94	.97	.98	.84	.91	.94	.97
EPMLE .25	.91	.96	.98	.99	.87	.93	.97	.98	.84	.91	.93	.97
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.82	.86	.91	.67	.82	.85	.91	.69	.83	.85	.91
NORMMLE	.71	.71	.72	.72	.68	.67	.66	.68	.66	.65	.64	.67
TMLE 1DF	.84	.92	.95	.97	.81	.88	.93	.95	.77	.87	.90	.93
TMLE 3DF	.84	.91	.94	.97	.80	.88	.92	.95	.77	.87	.89	.93
TMLE 10DF	.82	.90	.93	.96	.79	.86	.91	.94	.77	.86	.88	.92
EPMLE .1	.83	.91	.94	.96	.79	.86	.91	.93	.75	.85	.88	.92
EPMLE .25	.83	.90	.94	.96	.78	.86	.91	.93	.74	.85	.88	.92

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3 AND 3 FOR THE FIRST PARAMETER AND.7 AND 7 FOR THE SECOND PARAMETER.
2. THE ASSUMED VALUE FOR THE SCALE USED IN THE ALGORITHMS WAS .3 AND 3 FOR THE FIRST PARAMETER AND .7,7 FOR THE SECOND
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. BOX PATTERN

TABLE 48

P_H TRUE AND ASSUMED SCALES .3 AND .7, RHO .0, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.94	.96	.99	.99	.94	.96	.99	.99	.94	.96	.98	.99
NORMMLE	.97	.99	1	1	.97	1	1	1	.97	.99	1	1
TMLE 1DF	.97	.99	1	1	.97	.99	1	1	.97	.99	1	1
TMLE 3DF	.97	.99	1	1	.97	.99	1	1	.97	.99	1	1
TMLE 10DF	.97	.99	1	1	.97	.99	1	1	.97	.99	1	1
EPMLE .1	.97	.99	1	1	.97	.99	1	1	.97	.99	1	1
EPMLE .25	.97	.99	1	1	.97	.99	1	1	.97	.99	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.83	.91	.95	.96	.82	.92	.96	.96	.82	.92	.95	.97
NORMMLE	.86	.83	.83	.83	.84	.83	.84	.83	.85	.85	.83	.83
TMLE 1DF	.95	.98	.99	1	.93	.98	.99	.99	.95	.98	.99	1
TMLE 3DF	.94	.98	.99	1	.93	.98	.99	.99	.94	.98	.99	1
TMLE 10DF	.93	.97	.99	1	.92	.97	.99	.99	.92	.97	.99	1
EPMLE .1	.95	.98	.99	1	.94	.98	.99	.99	.94	.98	.99	1
EPMLE .25	.95	.98	.99	1	.94	.98	.99	.99	.95	.98	.99	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.86	.88	.93	.69	.86	.86	.91	.69	.84	.86	.92
NORMMLE	.70	.68	.66	.68	.70	.68	.65	.66	.71	.67	.64	.67
TMLE 1DF	.89	.95	.98	.99	.88	.95	.97	.99	.89	.95	.97	.99
TMLE 3DF	.89	.94	.97	.99	.87	.95	.97	.98	.89	.94	.96	.99
TMLE 10DF	.86	.92	.96	.97	.85	.92	.96	.98	.85	.92	.95	.98
EPMLE .1	.89	.95	.98	.99	.88	.96	.98	.98	.89	.95	.98	.99
EPMLE .25	.89	.95	.98	.99	.88	.96	.98	.99	.89	.95	.98	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.67	.83	.85	.90	.68	.82	.85	.90	.66	.82	.86	.90
NORMMLE	.69	.68	.70	.71	.70	.68	.69	.69	.68	.69	.71	.69
TMLE 1DF	.85	.90	.93	.96	.82	.89	.93	.96	.83	.89	.94	.96
TMLE 3DF	.84	.90	.93	.96	.82	.89	.93	.96	.82	.89	.93	.96
TMLE 10DF	.82	.89	.92	.95	.80	.88	.92	.95	.81	.87	.92	.95
EPMLE .1	.83	.88	.93	.95	.81	.88	.92	.95	.80	.88	.92	.95
EPMLE .25	.84	.89	.92	.95	.81	.88	.92	.95	.80	.88	.92	.95

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3 AND 3 FOR THE FIRST PARAMETER AND.7 AND 7 FOR THE SECOND PARAMETER.
2. THE ASSUMED VALUE FOR THE SCALE USED IN THE ALGORITHMS WAS .3 and 3 FOR THE FIRST PARAMETER AND .7,7 FOR THE SECOND
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0.
4. BOX PATTERN

TABLE 49

P_H TRUE AND ASSUMED SCALES .3 AND .7, RHO -.5, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.94	.95	.98	.98	.94	.96	.99	.99	.94	.96	.99	.99
NORMMLE	.93	.97	.99	.99	.95	.99	.99	1	.98	1	1	1
TMLE 1DF	.94	.97	.99	.99	.95	.98	.99	1	.98	1	1	1
TMLE 3DF	.94	.97	.99	.99	.96	.99	.99	1	.98	1	1	1
TMLE 10DF	.94	.98	.99	.99	.96	.99	.99	1	.98	1	1	1
EPMLE .1	.92	.97	.98	.99	.95	.99	.99	1	.98	1	1	1
EPMLE .25	.92	.96	.98	.99	.95	.98	.99	1	.98	1	1	1
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.83	.92	.95	.97	.84	.92	.95	.98	.84	.91	.96	.97
NORMMLE	.81	.80	.82	.81	.85	.84	.83	.82	.87	.84	.83	.83
TMLE 1DF	.91	.94	.97	.99	.93	.97	.99	.99	.96	.99	1	1
TMLE 3DF	.91	.94	.97	.99	.93	.97	.99	.99	.96	.99	1	1
TMLE 10DF	.90	.94	.97	.99	.92	.96	.99	.99	.95	.98	1	1
EPMLE .1	.90	.94	.97	.98	.93	.97	.99	.99	.96	.99	1	1
EPMLE .25	.89	.93	.96	.98	.93	.97	.99	.99	.96	.99	1	1
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.84	.88	.93	.70	.87	.88	.93	.68	.86	.86	.92
NORMMLE	.67	.65	.63	.64	.69	.64	.65	.63	.71	.66	.63	.64
TMLE 1DF	.85	.90	.95	.97	.87	.94	.97	.98	.90	.96	.98	.99
TMLE 3DF	.84	.90	.95	.97	.86	.93	.97	.98	.89	.95	.98	.99
TMLE 10DF	.82	.88	.93	.96	.84	.91	.96	.97	.87	.93	.96	.98
EPMLE .1	.84	.89	.95	.96	.87	.93	.97	.98	.91	.96	.99	.99
EPMLE .25	.84	.89	.95	.97	.87	.94	.97	.98	.91	.96	.99	.99
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.66	.82	.85	.90	.68	.84	.84	.90	.68	.84	.86	.89
NORMMLE	.63	.63	.64	.63	.67	.68	.67	.66	.72	.71	.72	.75
TMLE 1DF	.79	.86	.91	.94	.82	.89	.92	.95	.85	.91	.95	.97
TMLE 3DF	.79	.86	.91	.94	.81	.88	.92	.95	.85	.91	.95	.97
TMLE 10DF	.77	.84	.89	.93	.80	.87	.90	.94	.84	.90	.94	.96
EPMLE .1	.76	.83	.89	.93	.79	.87	.91	.94	.83	.90	.93	.96
EPMLE .25	.76	.83	.89	.93	.79	.87	.90	.94	.84	.90	.93	.96

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR WAS .3 AND 3 FOR THE FIRST PARAMETER AND.7 AND 7 FOR THE SECOND PARAMETER.
2. THE ASSUMED VALUE FOR THE SCALE USED IN THE ALGORITHMS WAS .3 and 3 FOR THE FIRST PARAMETER AND .7,7 FOR THE SECOND
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. BOX PATTERN

TABLE 50

P_H, TRUE SCALE .9, ASSUMED SCALE .5 , RHO 0.5, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.79	.79	.88	.88	.77	.79	.86	.88	.77	.79	.88	.88
NORMMLE	.80	.87	.91	.93	.74	.82	.88	.92	.73	.83	.88	.91
TMLE 1DF	.75	.82	.86	.90	.69	.78	.83	.87	.68	.78	.82	.86
TMLE 3DF	.77	.84	.88	.91	.71	.81	.85	.89	.69	.79	.84	.88
TMLE 10DF	.80	.86	.90	.92	.73	.82	.88	.91	.72	.81	.86	.89
EPMLE .1	.73	.81	.86	.88	.67	.75	.79	.84	.64	.73	.78	.81
EPMLE .25	.72	.80	.84	.87	.66	.74	.78	.82	.64	.73	.78	.81
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.75	.82	.84	.68	.74	.83	.84	.67	.76	.82	.85
NORMMLE	.70	.70	.73	.71	.67	.69	.70	.69	.63	.69	.69	.70
TMLE 1DF	.72	.80	.84	.86	.68	.74	.81	.85	.66	.75	.80	.84
TMLE 3DF	.74	.81	.86	.89	.70	.76	.84	.88	.67	.76	.82	.86
TMLE 10DF	.75	.82	.87	.89	.73	.78	.86	.90	.69	.78	.84	.87
EPMLE .1	.72	.77	.84	.85	.67	.72	.79	.83	.63	.71	.75	.81
EPMLE .25	.71	.76	.82	.84	.65	.70	.78	.82	.62	.71	.75	.80
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.58	.67	.73	.75	.55	.66	.71	.76	.56	.65	.71	.76
NORMMLE	.57	.53	.51	.46	.55	.51	.52	.47	.53	.52	.50	.49
TMLE 1DF	.69	.75	.81	.84	.63	.70	.76	.81	.61	.69	.74	.79
TMLE 3DF	.70	.77	.82	.86	.65	.71	.78	.83	.62	.70	.76	.81
TMLE 10DF	.71	.78	.83	.86	.66	.73	.80	.83	.64	.71	.77	.81
EPMLE .1	.66	.75	.80	.82	.61	.67	.74	.78	.59	.66	.71	.75
EPMLE .25	.65	.73	.78	.80	.60	.65	.72	.76	.58	.66	.70	.73
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.51	.65	.67	.73	.50	.65	.67	.72	.52	.65	.69	.74
NORMMLE	.53	.53	.52	.54	.47	.50	.49	.50	.48	.50	.49	.47
TMLE 1DF	.63	.73	.77	.82	.60	.70	.72	.77	.60	.67	.73	.78
TMLE 3DF	.63	.73	.78	.83	.60	.70	.73	.78	.60	.68	.73	.78
TMLE 10DF	.62	.72	.76	.82	.60	.69	.72	.79	.60	.67	.73	.77
EPMLE .1	.61	.70	.75	.81	.58	.66	.68	.73	.57	.65	.70	.74
EPMLE .25	.61	.70	.74	.80	.57	.65	.68	.73	.57	.64	.69	.74

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALES ARE .9 AND 9
3. THE ASSUMED SCALES ARE .5 AND 5
4. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
5. BOX PATTERN
6. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 51

P_H, TRUE SCALE .9, ASSUMED SCALE .5, RHO 0.0, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

EPSILON=0

	RHO = .5				RHO = 0				RHO = -.5			
	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.79	.79	.88	.88	.77	.79	.86	.88	.77	.79	.88	.88
NORMMLE	.79	.86	.90	.93	.77	.84	.89	.93	.77	.87	.90	.93
TMLE 1DF	.73	.81	.86	.89	.71	.79	.85	.88	.71	.81	.86	.89
TMLE 3DF	.76	.83	.87	.90	.74	.81	.86	.90	.74	.83	.88	.91
TMLE 10DF	.78	.85	.89	.92	.76	.83	.88	.92	.77	.85	.90	.92
EPMLE .1	.72	.80	.84	.88	.71	.78	.83	.87	.71	.80	.86	.88
EPMLE .25	.71	.79	.83	.86	.69	.76	.81	.85	.70	.79	.84	.87

EPSILON=.1

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.75	.82	.84	.68	.74	.83	.84	.67	.76	.82	.85
NORMMLE	.69	.71	.73	.71	.68	.71	.71	.71	.67	.72	.71	.71
TMLE 1DF	.71	.78	.83	.86	.70	.76	.83	.86	.70	.79	.84	.87
TMLE 3DF	.72	.80	.85	.88	.72	.78	.86	.89	.72	.80	.85	.89
TMLE 10DF	.74	.81	.86	.89	.74	.80	.87	.90	.73	.82	.87	.90
EPMLE .1	.71	.76	.82	.85	.70	.75	.83	.85	.70	.78	.83	.87
EPMLE .25	.70	.75	.81	.83	.69	.74	.81	.84	.69	.76	.81	.85

EPSILON=.25

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.58	.67	.73	.75	.55	.66	.71	.76	.56	.65	.71	.76
NORMMLE	.58	.52	.51	.48	.55	.53	.54	.47	.56	.54	.51	.51
TMLE 1DF	.67	.74	.79	.83	.65	.72	.78	.82	.66	.74	.78	.82
TMLE 3DF	.68	.76	.81	.84	.67	.74	.80	.84	.67	.75	.79	.84
TMLE 10DF	.70	.76	.82	.85	.68	.75	.81	.85	.68	.76	.81	.84
EPMLE .1	.66	.74	.78	.81	.65	.71	.77	.82	.65	.73	.77	.82
EPMLE .25	.65	.73	.78	.79	.63	.70	.75	.80	.64	.72	.76	.81

CAUCHY

	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.51	.65	.67	.73	.50	.65	.67	.72	.52	.65	.69	.74
NORMMLE	.51	.51	.50	.51	.50	.51	.50	.51	.52	.54	.53	.51
TMLE 1DF	.61	.71	.76	.81	.62	.70	.74	.78	.63	.72	.77	.81
TMLE 3DF	.62	.71	.76	.81	.62	.70	.74	.79	.64	.72	.77	.82
TMLE 10DF	.61	.70	.75	.80	.61	.70	.73	.80	.64	.72	.75	.80
EPMLE .1	.60	.68	.73	.79	.59	.68	.72	.75	.61	.69	.75	.78
EPMLE .25	.60	.68	.73	.79	.60	.68	.71	.75	.61	.69	.74	.78

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALE ARE .9 AND 9
3. THE ASSUMED SCALE ARE .5 AND 5
4. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0 .
5. BOX PATTERN
6. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 52

$P_{H,}$ TRUE SCALE .9, ASSUMED SCALE .5, RHO .5, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.79	.80	.88	.88	.76	.79	.87	.86	.77	.80	.86	.88
NORMMLE	.74	.82	.87	.92	.75	.85	.89	.92	.79	.87	.89	.93
TMLE 1DF	.68	.78	.83	.86	.69	.79	.82	.87	.74	.83	.86	.90
TMLE 3DF	.70	.80	.84	.88	.72	.81	.85	.89	.76	.85	.87	.91
TMLE 10DF	.73	.82	.86	.89	.74	.83	.87	.90	.78	.86	.89	.92
EPMLE .1	.66	.74	.79	.81	.67	.75	.80	.84	.73	.81	.85	.90
EPMLE .25	.66	.73	.79	.81	.66	.73	.78	.82	.72	.80	.83	.88
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.71	.76	.82	.83	.67	.74	.81	.83	.67	.75	.80	.83
NORMMLE	.67	.68	.69	.69	.66	.67	.69	.69	.69	.70	.71	.71
TMLE 1DF	.67	.74	.80	.83	.67	.72	.81	.87	.72	.79	.84	.88
TMLE 3DF	.68	.76	.81	.84	.68	.75	.82	.88	.73	.82	.86	.89
TMLE 10DF	.70	.76	.83	.86	.70	.76	.85	.90	.75	.83	.87	.90
EPMLE .1	.65	.71	.75	.79	.64	.70	.78	.83	.70	.78	.83	.87
EPMLE .25	.64	.70	.74	.77	.63	.69	.76	.81	.68	.77	.81	.86
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.53	.68	.72	.76	.59	.67	.71	.76	.55	.69	.70	.78
NORMMLE	.49	.52	.51	.50	.57	.52	.51	.49	.56	.57	.51	.50
TMLE 1DF	.59	.69	.76	.80	.65	.70	.77	.81	.68	.78	.80	.86
TMLE 3DF	.59	.70	.77	.82	.67	.71	.80	.82	.70	.80	.81	.87
TMLE 10DF	.59	.71	.78	.82	.69	.73	.81	.83	.70	.80	.82	.88
EPMLE .1	.57	.66	.71	.76	.65	.67	.74	.79	.67	.76	.79	.84
EPMLE .25	.56	.65	.70	.75	.63	.66	.73	.76	.66	.75	.77	.83
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.51	.65	.70	.74	.52	.64	.69	.76	.51	.66	.68	.75
NORMMLE	.49	.47	.49	.50	.51	.50	.50	.52	.53	.53	.55	.55
TMLE 1DF	.59	.67	.74	.76	.60	.67	.75	.79	.64	.73	.77	.81
TMLE 3DF	.60	.67	.73	.77	.61	.68	.76	.80	.65	.72	.77	.81
TMLE 10DF	.60	.65	.73	.77	.61	.67	.75	.80	.63	.72	.78	.82
EPMLE .1	.58	.63	.69	.73	.57	.64	.70	.76	.62	.69	.74	.78
EPMLE .25	.57	.63	.69	.72	.57	.63	.70	.75	.61	.69	.73	.78

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALES ARE .9 AND 9
3. THE ASSUMED SCALES ARE .5 AND 5
4. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
5. BOX PATTERN
6. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 53

P_H, TRUE AND ASSUMED SCALE .9, ASSUMED RHO 0.5, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.77	.81	.88	.88	.76	.80	.87	.88	.79	.79	.88	.87
NORMMLE	.78	.87	.91	.93	.75	.84	.89	.93	.74	.82	.87	.90
TMLE 1DF	.76	.85	.89	.91	.72	.80	.86	.90	.70	.78	.83	.88
TMLE 3DF	.77	.86	.91	.92	.74	.82	.87	.92	.73	.80	.86	.89
TMLE 10DF	.78	.87	.91	.93	.75	.84	.89	.92	.75	.81	.87	.90
EPMLE .1	.78	.87	.91	.93	.74	.83	.89	.92	.72	.79	.85	.88
EPMLE .25	.78	.87	.91	.93	.74	.83	.88	.92	.72	.79	.84	.87
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.75	.81	.84	.67	.75	.83	.84	.68	.75	.83	.83
NORMMLE	.70	.71	.70	.72	.65	.70	.72	.70	.63	.69	.70	.68
TMLE 1DF	.75	.81	.86	.89	.68	.78	.85	.88	.67	.77	.83	.85
TMLE 3DF	.76	.82	.87	.90	.70	.79	.87	.89	.69	.79	.84	.86
TMLE 10DF	.76	.82	.87	.90	.70	.79	.87	.89	.68	.78	.84	.86
EPMLE .1	.77	.84	.88	.91	.70	.80	.87	.90	.67	.79	.83	.85
EPMLE .25	.77	.84	.87	.91	.70	.79	.87	.89	.67	.78	.83	.84
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.54	.67	.72	.77	.56	.67	.71	.75	.56	.68	.72	.77
NORMMLE	.55	.54	.50	.50	.54	.52	.49	.48	.53	.52	.49	.49
TMLE 1DF	.69	.77	.82	.86	.65	.72	.77	.82	.62	.71	.76	.81
TMLE 3DF	.69	.78	.83	.87	.66	.73	.78	.83	.64	.71	.77	.82
TMLE 10DF	.67	.75	.81	.86	.65	.70	.77	.82	.61	.70	.74	.81
EPMLE .1	.69	.79	.84	.89	.66	.74	.80	.84	.63	.71	.77	.82
EPMLE .25	.69	.79	.85	.89	.66	.73	.80	.83	.63	.71	.76	.82
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.52	.65	.67	.74	.53	.65	.70	.75	.52	.65	.68	.75
NORMMLE	.54	.53	.53	.54	.51	.50	.51	.52	.48	.47	.47	.49
TMLE 1DF	.65	.71	.78	.83	.61	.69	.76	.80	.61	.66	.74	.78
TMLE 3DF	.64	.70	.77	.82	.61	.69	.76	.79	.59	.66	.73	.77
TMLE 10DF	.61	.68	.73	.78	.59	.66	.73	.77	.56	.64	.69	.76
EPMLE .1	.63	.69	.75	.78	.60	.66	.72	.75	.57	.64	.70	.74
EPMLE .25	.63	.69	.75	.79	.60	.67	.73	.76	.57	.64	.71	.75

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALES ARE .9 AND 9
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS .5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 54

P_H, TRUE AND ASSUMED SCALE .9, ASSUMED RHO 0.0, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.79	.79	.87	.89	.77	.80	.88	.86	.77	.79	.86	.88
NORMMLE	.79	.86	.89	.93	.77	.86	.91	.93	.77	.84	.90	.93
TMLE 1DF	.76	.82	.88	.91	.74	.83	.88	.89	.74	.82	.86	.90
TMLE 3DF	.78	.84	.89	.92	.76	.84	.90	.91	.76	.83	.88	.91
TMLE 10DF	.79	.85	.89	.93	.76	.86	.91	.92	.76	.84	.90	.92
EPMLE .1	.79	.85	.89	.93	.76	.86	.91	.92	.77	.84	.89	.92
EPMLE .25	.78	.85	.89	.93	.76	.86	.91	.92	.76	.84	.89	.92
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.69	.75	.82	.84	.70	.74	.81	.84	.68	.76	.83	.85
NORMMLE	.69	.71	.71	.70	.70	.72	.70	.72	.68	.72	.72	.70
TMLE 1DF	.73	.81	.84	.89	.72	.79	.85	.88	.72	.81	.87	.89
TMLE 3DF	.74	.82	.85	.90	.75	.80	.86	.90	.74	.82	.88	.90
TMLE 10DF	.73	.81	.86	.90	.75	.80	.85	.90	.73	.81	.88	.90
EPMLE .1	.74	.84	.87	.91	.76	.82	.87	.91	.74	.83	.89	.91
EPMLE .25	.74	.84	.86	.91	.76	.82	.87	.90	.74	.83	.89	.90
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.57	.67	.72	.76	.56	.68	.71	.77	.54	.66	.73	.76
NORMMLE	.57	.53	.50	.49	.56	.54	.49	.50	.54	.52	.52	.49
TMLE 1DF	.68	.76	.80	.86	.66	.74	.78	.84	.66	.77	.82	.84
TMLE 3DF	.68	.76	.80	.86	.68	.75	.79	.85	.67	.77	.83	.84
TMLE 10DF	.66	.74	.78	.84	.65	.73	.77	.83	.64	.74	.80	.82
EPMLE .1	.69	.77	.82	.87	.68	.76	.81	.87	.67	.77	.83	.86
EPMLE .25	.69	.77	.82	.87	.68	.76	.81	.87	.67	.77	.83	.86
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.51	.66	.68	.74	.53	.65	.67	.73	.51	.65	.67	.76
NORMMLE	.51	.53	.50	.53	.53	.51	.51	.49	.51	.51	.51	.53
TMLE 1DF	.63	.72	.76	.81	.62	.69	.74	.80	.64	.71	.77	.82
TMLE 3DF	.62	.71	.76	.80	.61	.68	.74	.79	.63	.69	.75	.81
TMLE 10DF	.60	.69	.73	.77	.58	.65	.70	.75	.60	.66	.71	.80
EPMLE .1	.61	.68	.72	.76	.60	.65	.70	.76	.61	.67	.71	.78
EPMLE .25	.61	.68	.73	.77	.60	.66	.71	.77	.61	.67	.72	.79

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALE ARE .9 AND 9
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS 0 .
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

TABLE 55

P_H, TRUE AND ASSUMED SCALES .9, ASSUMED RHO .5, BOX

CORRELATION COEFFICIENT USED TO GENERATE THE ERROR

	RHO = .5				RHO = 0				RHO = -.5			
EPSILON=0	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.77	.81	.88	.88	.76	.80	.87	.88	.79	.79	.88	.87
NORMMLE	.71	.83	.88	.92	.75	.84	.89	.93	.82	.86	.91	.93
TMLE 1DF	.69	.80	.85	.88	.71	.80	.86	.91	.78	.84	.89	.90
TMLE 3DF	.72	.82	.87	.90	.73	.83	.87	.92	.80	.85	.90	.92
TMLE 10DF	.72	.83	.88	.91	.75	.84	.89	.93	.81	.86	.91	.92
EPMLE .1	.71	.81	.85	.89	.74	.83	.88	.92	.81	.86	.91	.92
EPMLE .25	.70	.81	.85	.88	.73	.82	.88	.92	.81	.86	.90	.92
EPSILON=.1	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.68	.75	.81	.84	.67	.75	.83	.84	.68	.75	.83	.83
NORMMLE	.65	.68	.68	.70	.65	.71	.71	.70	.69	.73	.72	.69
TMLE 1DF	.68	.76	.79	.85	.67	.78	.85	.88	.74	.82	.87	.89
TMLE 3DF	.70	.78	.81	.87	.69	.79	.86	.89	.75	.84	.88	.90
TMLE 10DF	.70	.77	.81	.87	.69	.80	.86	.90	.75	.83	.88	.89
EPMLE .1	.69	.76	.81	.86	.70	.80	.87	.91	.76	.85	.90	.91
EPMLE .25	.69	.76	.80	.85	.69	.80	.86	.90	.76	.85	.89	.90
EPSILON=.25	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.54	.67	.72	.77	.56	.67	.71	.75	.56	.68	.72	.77
NORMMLE	.52	.51	.49	.49	.54	.53	.51	.50	.58	.54	.51	.49
TMLE 1DF	.61	.70	.77	.82	.66	.73	.79	.81	.69	.77	.82	.86
TMLE 3DF	.62	.71	.78	.83	.67	.73	.79	.83	.70	.78	.83	.87
TMLE 10DF	.61	.69	.76	.81	.65	.71	.77	.82	.68	.76	.81	.86
EPMLE .1	.61	.71	.78	.82	.66	.75	.80	.84	.71	.79	.84	.88
EPMLE .25	.61	.71	.77	.82	.66	.74	.80	.84	.71	.79	.85	.88
CAUCHY	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5	5/2	5/3	5/4	5/5
MEDIAN	.52	.65	.67	.74	.53	.65	.70	.75	.52	.65	.68	.75
NORMMLE	.48	.47	.48	.49	.52	.51	.51	.51	.54	.53	.52	.54
TMLE 1DF	.60	.66	.73	.77	.61	.70	.77	.80	.66	.72	.78	.83
TMLE 3DF	.59	.65	.73	.77	.61	.69	.75	.80	.65	.71	.78	.83
TMLE 10DF	.57	.63	.70	.74	.59	.66	.73	.77	.62	.68	.74	.80
EPMLE .1	.58	.64	.70	.73	.59	.67	.74	.77	.62	.68	.74	.80
EPMLE .25	.58	.64	.71	.73	.59	.67	.74	.77	.62	.68	.75	.80

NOTE:

1. THE VALUE OF THE SCALE USED TO GENERATE THE ERROR AND THE SCALE USED TO MAKE THE IDENTIFICATION ARE THE SAME.
2. THE TRUE SCALES ARE .9 AND 9
3. THE VALUE OF THE CORRELATION COEFFICIENT USED IN THE ALGORITHMS WAS -.5.
4. BOX PATTERN
5. AVERAGE OF 10 RUNS OF 200 TRIALS EACH

APPENDIX B

SIMULATION CODE FOR SINGLE PARAMETER CASE

```
//SC48N2   JOB (2341,9999),'FORTRAN A',CLASS=J
//*FORMAT PR,DDNAME=GO.FT06F001
//*FORMS=SEP1
//  EXEC FORTVCG
//FORT.SYSIN DD *
C...      THIS PROGRAM IS DESIGNED TO GENERATE PROBABILITIES OF CORRECT
C    IDENTIFICATION FOR SEVERAL BAYESIAN AND NON-BAYESIAN ALGORITHMS.
C    THE BAYESIAN METHODS INCLUDE AVERAGE, MEDIAN, MAXIMUM LIKELIHOOD
C    BASED ON THE STUDENT T, A MAXIMUM LIKELIHOOD BASED ON THE
C    MIXED NORMAL AND OTHERS.
C    THE BAYESIAN METHODS INCLUDE ONES BASED ON THE
C    NORMAL, STUDENT T, AND MIXED NORMAL.  IT DOES THIS FOR 2 THROUGH 5
C    OBSERVERS AND AN INPUTABLE NUMBER OF RUNS AND TRAILS FOR EACH.
C         THE PROGRAM FIRST PICKS A SEED BY CALLING SUBROUTINE DATIME.
C    THEN IT CALLS SUBROUTINE INPUT, WHICH CONTAINS  INPUTS FOR PARAMETERS
C    THE INPUTS INCLUDE CODES WHICH IDENTIFY THE ERROR DISTRIBUTIONS,
C    TRUE AND ASSUMED PARAMETERS, NUMBER OF RUNS AND TRAILS, NUMBER OF
C    RADARS TO BE OBSERVED AND THEIR PRIORS AND MEANS BOTH TRUE AND
C    ASSUMED.  THEN SUBROUTINE DRAW IS CALLED WHICH TAKES THE ERROR
C    DISTRIBUTION INFORMATION AND GENERATES AN ERROR FOR OBSERVATION.
C    THE MEAN OF THE BIRD AND THE ERROR ARE ADDED FOR I OBSERVATIONS
C    THEN USEING SEVERAL DIFFERENT ESTIMATION PROCEDURES, WE
C    ESTIMATE THE PROBABILITY FOR EACH MEAN.  WE SELECT THE MEAN WITH
C    THE HIGHEST PROBABILITY.  IF THE SELECTION IS CORRECT WE SCORE A 1
C    IF NOT A 0.  AT THE END OF EACH SET OF RUNS AN AVERAGE PERCENTAGE
C    OF CORRECT CHOICES IS COMPUTED.  THE  RESULTS ARE PRINTED AT THE END
C    OF THE BATCH OUTPUT.

C...          MAIN PROGRAM

C    INDICIES
C    --------

C    I      - REPRESENTS THE WATCHER NUMBER
C    ISAMPL - COUNTS THE NUMBER OF SAMPLES
C    IRUNS  - COUNTS THE NUMBER OF RUNS
C    J      - REPRESENTS THE BIRDS NUMBER
C    N      - NUMBER OF ESTIMATING METHODS

C    DEFINITIONS OF GLOBAL VARIABLES
C    -----------------------------

C      AMEAN(J)  - ASSUMED MEAN OF THE JTH BIRD, USED IN ESTIMATING ONLY
C      APRIOR(J) - ASSUMED PRIOR PROBABILITY FOR THE JTH BIRD USED
C                  IN THE ESTIMATING METHODS ONLY
C      Astdv1(I) - ASSUMED 1ST scale FOR THE ITH WATCHER, USED IN THE
C                  ESTIMATING METHODS ONLY
C      Astdv2(I) - ASSUMED 2ND scale FOR THE ITH WATCHER, USED IN THE
C                  ESTIMATING METHODS ONLY

C      IBIRD     - ASSUMED NUMBER OF BIRDS USED IN ESTIMATING METHODS ONLY
C      IDIST(I)  - ERROR DISTRIBUTION OF ITH WATCHER
C      ITRUE     - TRUE BIRD'S IDENTIFYING NUMBER
C      NBIRDS    - NUMBER OF BIRDS
C      NWATCH    - NUMBER OF WATCHERS

C      TDF(I)    - TRUE DEGREES OF FREEDOM FOR ERROR OF ITH WATCHER
```

```
C      EPS(I)      - TRUE VALUE OF EPSILON USED IN MIXED NORMAL ERROR
C                    FOR THE ITH WATCHER
C      TMEAN(J)    - TRUE MEAN OF THE JTH BIRD
C      TPRIOR(J)   - A PRIORI PROBABLITY OF BIRD J
C      Tstdv1(I)   - TRUE scale FOR THE NORMAL, t AND FIRST TERM OF THE
C                    MIXED NORMAL ERROR FOR THE ITH WATCHER
C      Tstdv2(I)   - TRUE scale OF THE SECOND TERM IN MIXED NORMAL


C    DEFINITIONS OF LOCAL VARIABLES
C    ------------------------------

C      CNT(N)      - COUNTER FOR THE NUMBER OF SUCCESSES BY METHOD N
C      DSEED       - DOUBLE PRECISION SEED FOR RANDOM NUMBER GENERATORS
C      REPS(N)     - NUMBER OF SUCCESSES DIVIDED BY NUMBER OF SAMPLES
C      NSAMPL    - NUMBER OF SAMPLES FOR EACH RUN
C      NRUN      - NUMBER OF RUNS



       COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
       COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
       COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

       REAL REPS(15,250) ,REPMN(4,4,15), EPS(10)
       REAL CNT(15)
       DOUBLE PRECISION DSEED

       CALL DATIME(I1,I2,I3,I4,I5,I6,I7,I8)
       DSEED=123455.D0 *(I6+I8+I7+1)
       CALL INPUT(EPS)

       DO 350 M=1,4
          TEPS=EPS(M)

       DO 250 NWATCH=2,5

C...THE FOLLOWING DO LOOP DOES THE RUNS

       DO 100 IREPS = 1,NRUN

C.......INTIATIALIZE COUNTERS FOR THE NUMBER OF CORRECT ANSWERS

          DO 10 N  = 1,15
             CNT(N)=0
   10     CONTINUE

          DO 50 ISAMPL=1,NSAMPL

C..........THIS SUBROUTINE DRAWS THE RANDOM NUMBERS AND COMPUTES THE
C             OBSERVATIONS

             CALL DRAW(DSEED,TEPS)

C..........CALL THE SUBROUTINES WHICH COMPUTE THE THREE ESTIMATORS
C              TBAYES COMPUTES METHODS A AND B, NORMBY DOES METHOD C

             CALL NORMBY(CNT(4))
             CALL EPSBAY(CNT(8),.1)
             CALL EPSBAY(CNT(10),.25)
             CALL TBAYES(1.,CNT(1))
             CALL TBAYES(3.,CNT(2))
             CALL TBAYES(10.,CNT(3))

             CALL MEAN(CNT(5),CNT(6),CNT(14))
             CALL VOTE(X,AMEAN,NWATCH,IBIRD,CNT(15),ITRUE)
```

```
              CALL BIWGHT(CNT(7),IFL3)
              CALL TMLE(NWATCH,X,ASTDV1,1.,CNT(12),AMEAN,IBIRD,ITRUE)
              CALL TMLE(NWATCH,X,ASTDV1,3.,CNT(13),AMEAN,IBIRD,ITRUE)
              CALL EPSMLE(CNT(9),.1,IFL1)
              CALL EPSMLE(CNT(11),.25,IFL2)
 50       CONTINUE

C........MEAN NUMBER OF CORRECT CHOICES FOR 1000 RUNS BY METHOD A

          DO 75 N = 1,15
              REPS(N,IREPS) = CNT(N)/NSAMPL
  75      CONTINUE

 100  CONTINUE
C...NOW WE COMPUTE THE MEAN FOR EACH METHOD
        DO 125 N = 1,15
          SUM=0
          DO 110 IREPS = 1, NRUN
              SUM = SUM + REPS(N,IREPS)
 110      CONTINUE
          SUM=SUM/NRUN
          REPMN(M,NWATCH-1,N) = SUM
 125  CONTINUE
 250  CONTINUE
 350  CONTINUE


C...OUTPUT FOLLOWS

       WRITE(6,298)TSTDV1(1)
 298  FORMAT('STD=',F3.2,'  DF=1')
       WRITE(6,299)
 299  FORMAT (' ALGORITHM',2X,4('5/2 5/3 5/4 5/5',3X))

       WRITE(6,303) ((REPMN(M,N,4),N=1,4),M=1,4)
 303  FORMAT (' BAYES NORM ',4(4(F3.2,1X),2X))

       WRITE(6,304) ((REPMN(M,N,8),N=1,4),M=1,4)
 304  FORMAT (' BAYES EP.1 ',4(4(F3.2,1X),2X))

       WRITE(6,305) ((REPMN(M,N,10),N=1,4),M=1,4)
 305  FORMAT (' BAYES E.25 ',4(4(F3.2,1X),2X))

       WRITE(6,300) ((REPMN(M,N,1),N=1,4),M=1,4)
 300  FORMAT (' BAYES T1DF ',4(4(F3.2,1X),2X))

       WRITE(6,301) ((REPMN(M,N,2),N=1,4),M=1,4)
 301  FORMAT (' BAYES T3DF ',4(4(F3.2,1X),2X))

       WRITE(6,302) ((REPMN(M,N,3),N=1,4),M=1,4)
 302  FORMAT (' BAYES T10D ',4(4(F3.2,1X),2X))

       WRITE(6,306)
 306  FORMAT( 60('-'))
       WRITE(6,306)

       WRITE(6,307) ((REPMN(M,N,5),N=1,4),M=1,4)
 307  FORMAT (' AVERAGE    ',4(4(F3.2,1X),2X))

       WRITE(6,320) ((REPMN(M,N,14),N=1,4),M=1,4)
```

```
320  FORMAT (' WEIGH MEAN ',4(4(F3.2,1X),2X))
      WRITE(6,308) ((REPMN(M,N,6),N=1,4),M=1,4)
308  FORMAT (' MEDIAN     ',4(4(F3.2,1X),2X))
      WRITE(6,321) ((REPMN(M,N,15),N=1,4),M=1,4)
321  FORMAT (' VOTING     ',4(4(F3.2,1X),2X))
      WRITE(6,309) ((REPMN(M,N,7),N=1,4),M=1,4)
309  FORMAT (' BIWEIGHT   ',4(4(F3.2,1X),2X))
      WRITE(6,312) ((REPMN(M,N,12),N=1,4),M=1,4)
312  FORMAT (' MLE T 1DF  ',4(4(F3.2,1X),2X))
      WRITE(6,313) ((REPMN(M,N,13),N=1,4),M=1,4)
313  FORMAT (' MLE T 3DF  ',4(4(F3.2,1X),2X))
      WRITE(6,310) ((REPMN(M,N,9),N=1,4),M=1,4)
310  FORMAT (' MLE EPS .1 ',4(4(F3.2,1X),2X))
      WRITE(6,311) ((REPMN(M,N,11),N=1,4),M=1,4)
311  FORMAT (' MLE EPS.25 ',4(4(F3.2,1X),2X))
      STOP
      END
```

```
C                *******************
C                * SUBROUTINE INPUT *
C                *******************

C...THIS SUBROUTINE CONTAINS ALL THE COMMANDS FOR INPUTING THE NECESSARY
C   INFORMATION


      SUBROUTINE INPUT(EPS)

      COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
      COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
      COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)
      REAL EPS(10)

C...ENTER THE NUMBER OF RUNS AND SAMPLES PER RUN

      NRUN = 10
      NSAMPL=1000

C...ENTER THE NUMBER OF BIRDS

      NBIRDS=5

C...ENTER THE VALUES FOR EPSILON

      EPS(1)=0
      EPS(2)=.1
      EPS(3)=.25
      EPS(4)=4

C...INPUT THE MEANS

      TMEAN(1)= 1
      TMEAN(2)= 2
      TMEAN(3)= 3
      TMEAN(4)= 4
      TMEAN(5)= 5

C...INPUT THE A PRIOR PROBABILITIES FOR EACH BIRD

      TPRIOR(1)=.2
      TPRIOR(2)=.2
      TPRIOR(3)=.2
      TPRIOR(4)=.2
      TPRIOR(5)=.2
C.......INPUT THE PARAMETERS FOR THE SELECTED ERROR DISTRIBUTION

         TSTDV1(1)=.4
         TSTDV2(1)= 4
         TDF(1)=1

         TSTDV1(2)=.5
         TSTDV2(2)= 5
         TDF(2)=1

         TSTDV1(3)=.6
         TSTDV2(3)= 6
         TDF(3)=1

         TSTDV1(4)=.7
         TSTDV2(4)= 7
```

```
          TDF(4)=1

          TSTDV1(5)=.8
          TSTDV2(5)=.8
          TDF(5)=1

C...ANALYSIS PARAMETERS

C...     ENTER THE NUMBER OF BIRDS BELIEVED TO BE IN AREA

         IBIRD=5

C...     ENTER THE ASSUMED MEANS

          AMEAN(1)=1
          AMEAN(2)=2
          AMEAN(3)=3
          AMEAN(4)=4
          AMEAN(5)=5

C...     ENTER THE ASSUMED A PRIORI PROBABILITIES

          APRIOR(1)=.2
          APRIOR(2)=.2
          APRIOR(3)=.2
          APRIOR(4)=.2
          APRIOR(5)=.2

C...     ENTER THE ASSUMED DEGREES OF FREEDOM

          ASTDV1(1)=.4
          ASTDV2(1)=.4

          ASTDV1(2)=.5
          ASTDV2(2)=5

          ASTDV1(3)=.6
          ASTDV2(3)=6

          ASTDV1(4)=.7
          ASTDV2(4)=7

          ASTDV1(5)=.8
          ASTDV2(5)=8
      RETURN
      END
```

```
C           ******************
C           * SUBROUTINE DRAW *
C           ******************

C...THIS SUBROUTINE DRAWS A MEAN BASED ON THE INPUTTED A PRIORI PROBABIL
C   ITIES.  THEN USING THE SELECTED DISTRIBUTION COMPUTES THE ERROR AND
C   COMBINES THEM TO GIVE AN OBSERVATION FOR OBSERVER I.  THIS OBSERVATI-
C   ON IS CALLED X(I).

C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C     CUMPRO - CUMMALTIVE PROBABILITY FOR THE JTH BIRD
C     DELTA  - IS THE ERROR TERM IN THE OBSERVATION
C     FK     - INVERSE OF THE DEGREES OF FREEDOM FOR T-DISTRIBUTION
C     PK     - ONE HALF THE DEGREES OF FREEDOM  FOR T-DISTRIBUTION
C     RANDOM - UNIFORM RANDOM NUMBER USED TO DRAW MEAN
C     RAN2   - GAMMA RANDOM VARIABLE USED IN T-DISTRIBUTION
C     RAN3   - NORMAL RANDOM VARIABLE

      SUBROUTINE DRAW(DSEED,TEPS)

      COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
      COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
      COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

      REAL WK(2)
      DOUBLE PRECISION DSEED

      CUMPRO=0
      RANDOM = GGUBFS(DSEED)
      DO 50 J = 1,NBIRDS

C...CALCULATE THE CUMMALTIVE PROBABILITIES

         CUMPRO=CUMPRO+TPRIOR(J)

C...IF THE UNIFORM RANDOM NUMBER IS LESS THAN THE CUMMALATIVE
C   PROBABILITY OF BIRD J, THEN THE JTH MEAN IS SELECTED

         IF ( RANDOM .LT. CUMPRO  ) THEN
               ZMEAN = TMEAN(J)
               ITRUE=J
               GO TO 75
         END IF
   50 CONTINUE

   75 IF ( TEPS .GT. 1) THEN

         DO 80 I=1,NWATCH

C...     COMPUTES ERROR BASED ON T DIST FROM THE IMSL LIBRARY

                   FK = 1./TDF(I)
                   PK = TDF(I)/2.
                   CALL GGNML(DSEED,1,RAN3)
                   CALL GGAMR(DSEED,PK,1,WK,RAN2)
                   IF(RAN2 .LT. .00000001)     RAN2 = .00000001
                   T=RAN3/SQRT((RAN2+RAN2)*FK)

                   X(I)=ZMEAN + T*TSTDV1(I)
   80    CONTINUE
```

```
      ELSE
         DO 100 I = 1,NWATCH
C...     COMPUTES ERROR BASED ON EPSILON CONTAMINATION OR NORMAL
                     RAN2 = GGUBFS(DSEED)
                     CALL GGNML(DSEED,1,RAN3)

                     IF ( RAN2 .GT. TEPS) THEN
                          DELTA = RAN3*TSTDV1(I)
                       ELSE
                          DELTA = RAN3*TSTDV2(I)
                     END IF

                     X(I)=ZMEAN + DELTA
  100    CONTINUE
      END IF
      RETURN
      END
```

```
C            ****************************************************
C            * SUBROUTINE TO IDENTIFY BASED ON T ERROR AND BAYES *
C            ****************************************************

C...THIS SUBROUTINE ESTIMATES THE PROBABILITIES OF EACH BIRD BEING THE
C   OBSERVED BIRD.  IT DOES THIS BY USING THE STUDENT T BASED BAYESIAN
C   APPROACH MENTIONED IN CHAPTER 3 OF THE THESIS.
C   IT ALSO COUNTS THE NUMBER OF TIMES EACH ESTIMATION PROCEDURE WAS
C   CORRECT.  CORRECT BEING THE BIRD WITH THE HIGHEST PROBABILITY
C   WAS THE TRUE BIRD BEING OBSERVED.

C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C      CNTA1     - COUNT NUMBER OF CORRECT ANSWERS BY UNWEIGHTED ESTIMATE
C      DI        - DEGREES OF FREEDOM TO BE USED IN EVALUATION
C      MAXA      - MAXIMUM VALUE BY METHOD A
C      PROBA(J)  - POSTERIOR PROBABILITY BY METHOD A
C      SUM       - SUMS FOR METHOD A
C      SUMA      - SUMS FOR METHOD A
C      TESTA     - USED TO TEST AND RETAIN LARGEST VALUE FOR METHOD A
C      UA(J)     - HOLDER

       SUBROUTINE TBAYES(DI,CNTA1)

       COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
       COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
       COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

       REAL UA(10),PROBA

       SUMA = 0
       TESTA = 0
       DO 100 J = 1,IBIRD
           SUM = 0


           DO 50 I = 1,NWATCH
               SUM=SUM+(DI+1)*LOG(1+(((X(I)-AMEAN(J))/ASTDV1(I))**2)/DI)
  50     CONTINUE

C...          THIS IF STATEMENT PREVENTs TO GREAT A ARGUMENT FOR EXP

               IF (SUM .GT. 345.) SUM = 345.
           UA(J) = 1./EXP(.5*SUM)
           SUMA = SUMA + APRIOR(J)*UA(J)

 100   CONTINUE

       DO 200 J = 1,IBIRD
           PROBA    = APRIOR(J)*UA(J)/SUMA
           IF ( PROBA    .GT. TESTA) THEN
               TESTA = PROBA
               MAXA = J
           END IF
 200   CONTINUE
       IF ( MAXA .EQ. ITRUE) CNTA1= CNTA1+ 1
       RETURN
       END
```

```
C              *******************************************
C              * SUBROUTINE FOR BAYES BASED ON NORMAL ERROR *
C              *******************************************

C...THIS IS A BAYSIAN ESTIMATE OF THE POSTERIOR PROBABILITIES
C   OF EACH BIRD BEING THE OBSERVED BIRD.
C   THIS SUBROUTINE USES THE BAYESIAN METHOD BASED ON THE NORMAL.
C   IT ALSO COUNTS THE NUMBER OF TIMES EACH ESTIMATION PROCEDURE WAS
C   CORRECT.  CORRECT BEING THE BIRD WITH THE HIGHEST PROBABILITY
C   WAS THE TRUE BIRD BEING OBSERVED.

C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C      COUNTC    - COUNTS THE NUMBER OF CORRECT PICKS FOR EACH RUN
C      MAXB      - CONTAINS THE IDENTIFYING NUMBER FOR THE BIRD WHICH HAD
C                  THE MAXIMUM POSTERIOR PROBABILITY
C      PROBB     - POSTERIOR PROBABILITY
C      SUMB      - DENOMINATOR OF POSTERIOR PROBABILITY
C      SUM2      - SUM IN THE EXPONENT WITHOUT THE .5 MULTIPLE
C      TESTB     - MAXIMUM POSTERIOR
C      UB(J)     - M(J) IN THE THESIS WRITE UP


      SUBROUTINE NORMBY(COUNTC)

      COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
      COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
      COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

      REAL UB(10),PROBB

      SUMB=0
      DO 100 J = 1,IBIRD

         SUM2 = 0

C...   FOLLOWING SUMS OVER I: THE OBSERVATION BY THE ITH WATCHER MINUS TH
C      MEAN OF THE JTH BIRD, ALL DIVIDED BY THE SQUARE ROOT OF THE SPREAD
C      AND THEN SQUARED

         DO 50 I = 1,NWATCH

            SUM2 = SUM2 + (((X(I)-AMEAN(J))/ASTDV1(I))**2)

 50      CONTINUE

C...CHECK FOR NUMBER THAT WOULD BE TO LARGE FOR EXP

         IF(SUM2 .GT. 345.) SUM2 = 345.
         UB(J) =1/EXP(.5*SUM2)
         SUMB = SUMB + APRIOR(J)*UB(J)

100   CONTINUE

      TESTB = 0

C...   THE FOLLOWING COMPUTES THE ESTIMATED POSTERIORS FOR METHOD C AND
C         THEN FINDS THE J ASSOCIATED WITH THE LARGEST POSTERIOR

      DO 200 J = 1,IBIRD

         PROBB    =APRIOR(J)*UB(J)/SUMB
         IF ( PROBB     .GT. TESTB) THEN
            TESTB = PROBB
            MAXB = J
```

```
      END IF
200  CONTINUE
     IF ( MAXB .EQ. ITRUE) COUNTC = COUNTC + 1
     RETURN
     END
```

```
C          ****************************************************
C          * SUBROUTINE TO IDENTIFY BASED ON MIXED NORMAL BAYES *
C          ****************************************************

C...BAYSIAN METHOD WHICH ASSUMES MIXED NORMAL ERROR.  THIS GENERATES A
C   POSTERIOR PROBABILITY.  THE MEAN OF RADAR WITH THE HIGHEST POSTERIOR
C   PROBABILITY IS COMPARED TO THE TRUE RADAR'S MEAN.  IF THEY'RE THE
C   SAME THEN A ONE IS ADDED TO THE COUNT.

C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C     COUNT   - COUNT CORRECT CHOICES
C     DIFF    - DIFFERENCE BETWEEN OBSERVATION AND ASSUMED MEAN OF JTH
C               BIRD
C     EPS     - VALUE OF EPSILON USED IN ESTIMATOR
C     PU(J)   - NATURAL LOG OF POSTERIOR PROBABILITY
C     RMAX    - CURRENT VALUE OF MAXIMUM POSTERIOR
C     R1      - HOLDER IN CALCULATIONS
C     R2      - HOLDER IN CALCULATIONS
C     T       - HOLDER IN CALCULATIONS

      SUBROUTINE EPSBAY(COUNT,EPS)

      COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
      COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
      COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

      REAL PU(20)

      RMAX=-10000
      DO 50 J=1,IBIRD

          PU(J)=0
          DO 25 I = 1,NWATCH

              DIFF=ABS(X(I)-AMEAN(J))

              R1=(1-EPS)*(ASTDV2(I)/ASTDV1(I))
              T=.5*(DIFF**2)*((1/(ASTDV1(I)**2))-(1/(ASTDV2(I))**2) )
              IF ( T .GT. 174. ) T = 174
              R1=LOG((R1/EXP(T)) + EPS)
              R2=LOG(SQRT(6.2832)*ASTDV2(I))+(.5*(DIFF/ASTDV2(I))**2)
              PU(J)=PU(J)+R1-R2

25      CONTINUE
              IF ( APRIOR(J) .EQ. 0 ) THEN
                      PU(J)=-100000
                  ELSE
                      PU(J)=LOG(APRIOR(J))+ PU(J)
              END IF

          IF( PU(J) .GT. RMAX) THEN
              RMAX=PU(J)
              MAX=J
          END IF

50 CONTINUE

      IF(MAX .EQ. ITRUE) COUNT = COUNT+1
      RETURN
      END
```

```
C             ********************
C             * SUBROUTINE MEAN *
C             ********************

C...THIS SUBROUTINE IDENTIFYIES THE BIRD BY THE MEAN OF THE OBSERVATIONS
C   AND BY THE MEDIAN.  IT DETERMINES THE MEAN AND THE MEDIAN, THEN FIND
C   THE CLOSET BIRD.  IF THE BIRD CHOSEN IS THE RIGHT ONE, THEN IT SCORE
C   A ONE; OTHERWISE ITS A ZERO.

C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C      AMEDIN   - HOLDS MEDIAN OF THE OBSERVATIONS
C      COUNTD   - COUNTS THE NUMBER OF CORRECT PICKS BY THE MEAN
C      COUNTE   - COUNTS THE NUMBER OF CORRECT PICKS BY THE MEDIAN
C      MUM      - HOLDER FOR INDEX FOR ODERING OBSERVATIONS
C      RMEAN    - MEAN OF THE OBSERVATIONS
C      RMEDIN   - MEDIAN OF THE OBSERVATIONS
C      SMAL(J)  - ORDERED OBSERVATIONS
C      SMALL    - HOLDER
C      SUM      - SUM OF THE OBSERVATIONS

      SUBROUTINE MEAN(COUNTD,COUNTE,COUNTF)

      COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
      COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
      COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

C...COMPUTE THE AVERAGE AND THE WEIGHTED MEAN OF THE OBSERVATIONS

      SUM=0
      SUMTOP=0
      SUMBOT=0

      DO 50 I=1,NWATCH
         SUM = SUM + X(I)
         SUMTOP = SUMTOP + X(I)/ASTDV1(I)
         SUMBOT = SUMBOT + 1./ASTDV1(I)
 50   CONTINUE

      RMEAN = SUM/NWATCH
      WMEAN = SUMTOP/SUMBOT

      COUNTD=COMPAR(AMEAN,IBIRD,ITRUE,RMEAN,COUNTD)
      COUNTF=COMPAR(AMEAN,IBIRD,ITRUE,WMEAN,COUNTF)


C...COMPUTE MEDIAN

      AMEDIN=RMEDIN(X,NWATCH)

C...CHECKS TO SEE IF MEDIAN WITH IN .5 OF TRUE VALUE IF IT IS ADD 1

      COUNTE=COMPAR(AMEAN,IBIRD,ITRUE,AMEDIN,COUNTE)

      RETURN
      END
```

```
      SUBROUTINE VOTE(X,U,NWATCH,IBIRD,COUNTG,ITRUE)
      REAL X(10),U(10)
      INTEGER COUNT(10)

      DO 10 N=1,IBIRD
         COUNT(N)=0
 10   CONTINUE

      DO 75 I=1,NWATCH
         IF ( X(I) .LE. U(1)+.5) THEN
               COUNT(1)=COUNT(1)+1
               GO TO 75
         END IF
         IF(X(I) .GE. U(IBIRD)-.5) THEN
               COUNT(IBIRD)=COUNT(IBIRD)+1
               GO TO 75
         END IF
         DO 50 N=2,IBIRD-1
            IF ( X(I) .LE. U(N)+.5 .AND. X(I) .GE. U(N)-.5) THEN
               COUNT(N)=COUNT(N)+1
               GO TO 75
            END IF
 50        CONTINUE
 75   CONTINUE

C...NOW FIND THE BIRD WITH THE MAXIMUM NUMBER OF HITS, IF 2 OR MORE
C   EQUAL THEN TAKE MEDIAN

      MAX1=COUNT(1)
      MAX=1
      MAX2=0

      DO 125 N=2,IBIRD
         IF( COUNT(N) .GT.MAX1) THEN
               MAX1=COUNT(N)
               MAX=N
            ELSE IF ( COUNT(N) .EQ. MAX1) THEN
               MAX2=COUNT(N)
         END IF
 125  CONTINUE

      IF ( MAX1 .EQ. MAX2 ) THEN
            AMED=RMEDIN(X,NWATCH)
            COUNTG=COMPAR(U,IBIRD,ITRUE,AMED,COUNTG)
         ELSE
            IF ( MAX .EQ. ITRUE ) COUNTG=COUNTG+1
      END IF

      RETURN
      END
```

```
C           ********************
C           * SUBROUTINE BIWGHT *
C           ********************

C...THIS SUBROUTINE IDENTIFYIES THE BIRD BY THE METHOD OF BIWEIGHTS
C   DESCRIBED IN REFERENCE 5.  A UHAT IS GENERATED THAT IS
C   THEN COMPARED TO THE GIVEN MEANS OF THE BIRDS.


C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C     ALSTOP   - COUNTS ITERATIONS AND STOPS IF EXCEEDS 1000
C     DIFF(I)  - RETAINS DIFFERENCES BETWEEN OBSERVATIONS AND UHAT
C     S        -
C     SUM      - USED TO SUM NUMERATOR
C     SUM2     - SUMS THE DENOMINATOR
C     UHAT     - THE CURRENT ESTIMATE OF THE TRUE MEAN
C     U1       - RETAINS MEDIAN
C     U2       - THE LATEST ESTIMATE OF THE TRUE MEAN
C     W        - THE WEIGHT


      SUBROUTINE BIWGHT(BIWAIT,IFLAG)

      COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
      COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
      COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

      REAL DIFF(10)

      U1 = RMEDIN(X,NWATCH)
      UHAT = U1
      ALSTOP=0

C...COMPUTE THE ABSOLUTE VALUE BETWEEN THE DIFFERENCES IN X(I) AND MEDIA

   10 DO 50 I = 1 ,NWATCH
          DIFF(I)=ABS(X(I)-UHAT)
   50 CONTINUE

      S = RMEDIN(DIFF,NWATCH)
      IF(S.EQ.0) S=.000001
      SUM=0
      SUM2=0

   60 DO 75 I = 1,NWATCH

          IF ( ((X(I)-UHAT)/(6*S))**2 .LT. 1.) THEN

                W=(1-((X(I)-UHAT)/(6*S)) **2)**2
             ELSE
                W=0
          END IF

          SUM = SUM + W*X(I)
          SUM2 = SUM2 + W
   75 CONTINUE
      IF ( SUM2 .LT. .0000001) THEN
             U2=0
          ELSE
             U2=SUM/SUM2
      END IF
      IF(ALSTOP .GT. 1000)THEN
          IFLAG=IFLAG+1
          UHAT=U1
          GO TO 100
      END IF
```

```
      IF(ABS(U2-UHAT) .GT. .0001) THEN
         UHAT = U2
         ALSTOP=ALSTOP+1
         GO TO 10
      END IF
100   BIWAIT=COMPAR(AMEAN,IBIRD,ITRUE,UHAT,BIWAIT)
      RETURN
      END
```

```
C       ****************************************
C       * ITERATIVE REWEIGHTING TO FIND THETA *
C       ****************************************

C...        THIS ROUTINE USES A MAXIMUM LIKELIHOOD ESTIMATOR BASED ON THE
C    STUDENT T TO COMPUTE AN ESTIMATE OF THE TRUE MEAN.  THIS ESTIMATE IS
C    THEN COMPARED TO THE TRUE MEANS AND THE ONE IT IS CLOSEST TO IS
C    CHOSEN TO BE THE RADAR THAT IS SENDING.  THIS IS THEN COMPARED TO
C    THE TRUE NUMBER OF THE ACTUAL RADAR SENDING.  IF IT'S CORRECT A
C    ONE IS ADDED TO THE COUNT.

C    DEFINITION OF LOCAL VARIABLES
C    ----------------------------

C    ALSTOP    - COUNTS ITERATIONS AND STOPS IF EXCEEDS 1000
C    BOTTOM    - DENOMINATOR FOR ESTIMATE OF THETA
C    LOW       - LOWER LIMIT FOR CONVERGENCE OF THE ESTIMATORS
C    THETA     - ESTIMATE OF THE TRUE PARAMETER OF THE SENDING RADAR
C    TOP       - NUMERATOR OF THETA ESTIMATE
C    UP        - UPPER LIMIT FOR CONVERGENCE


      SUBROUTINE TMLE(NUMB,Y,SIGMP,DFP,COUNT,AMEAN,IBIRD,ITRUE)
      REAL Y(10),SIGMP(10),W(10),AMEAN(10)

C...COMPUTE MEDIAN OF OBSERVATIONS

          THETA=RMEDIN(Y,NUMB)

C...NOW,COMPUTE THE VALUE FOR THE WEIGHTS AND THE NEXT THETA

          HOLD=THETA
          UP=HOLD+.0001
          LOW=HOLD-.0001
          DO 100 J=1,1000

            TOP=0
            BOTTOM=0

            DO 75 I =1,NUMB

              W(I)=(DFP+1.)/DFP
              W(I)=W(I)/(1.+(((Y(I)-THETA)**2)/(SIGMP(I)*DFP)))
              TOP=TOP +((Y(I)*W(I))/SIGMP(I))
              BOTTOM=BOTTOM +(W(I)/SIGMP(I))

 75         CONTINUE

            THETA=TOP/BOTTOM
            IF (THETA .LT. UP .AND. THETA .GT. LOW) GO TO 110
            HOLD=THETA
            UP=HOLD+.0001
            LOW=HOLD-.0001
100   CONTINUE
105   THETA=RMEDIN(Y,NUMB)
110   COUNT=COMPAR(AMEAN,IBIRD,ITRUE,THETA,COUNT)
      RETURN
      END
```

```
C          ***********************************************
C          * SUBROUTINE TO IDENTIFY BASED ON MIXED NORMAL MLE *
C          ***********************************************

C...COMPUTES MAXIMUM LIKILHOOD ESTIMATOR OF MEAN BASED ON MIXED NORMAL
C   ERROR.
C
C

C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C     ALSTOP  - COUNTS ITERATION AND STOPS IF GREATER THAN 1000
C     COUNT   - COUNTS CORRECT CHOICES
C     EPS     - VALUE OF EPSILON USED IN ESTIMATOR
C     IFLAG   - COUNTS NUMBER OF TIMES EXCEEDS 1000 ITERATIONS
C     SUM     - SUMS NUMERATOR
C     SUM2    - SUMS DENOMINATOR
C     T       - HOLDER FOR CALCULATIONS
C     UHAT    - CURRENT ESTIMATE OF MEAN
C     U1      - MEDIAN OF OBSERVATIONS
C     U2      - LATEST ESTIMATE OF MEAN
C     V       - HOLDER FOR CALCULATIONS
C     V1      - VARIANCES OF FIRST TERM IN MIXED NORMAL
C     V2      - VARIANCE OF SECOND TERM IN MIXED NORMAL

      SUBROUTINE EPSMLE(COUNT,EPS,IFLAG)

      COMMON AMEAN(10),APRIOR(10),ASTDV1(10),ASTDV2(10)
      COMMON IBIRD, ITRUE,NBIRDS,NWATCH,NRUN,NSAMPL,X(10)
      COMMON TDF(10),TMEAN(10),TPRIOR(10),TSTDV1(10),TSTDV2(10)

      UHAT=RMEDIN(X,NWATCH)
      ALSTOP = 0

   10 SUM=0
      SUM2=0
      DO 50 I = 1,NWATCH
          V1=ASTDV1(I)**2
          V2=ASTDV2(I)**2

          T=(.5)*((X(I)-UHAT)**2)*((1/V1)-(1/V2))
        IF ( T .GT. 174.0) T= 174.0

        W=(1-EPS)*(ASTDV2(I)/ASTDV1(I))/EXP(T)

         W=W/(EPS+W)

         V=(1/V2)+W*((1/V1)-(1/V2))

         SUM=SUM+X(I)*V

         SUM2=SUM2+V

   50 CONTINUE

      U2=SUM/SUM2

      IF (ALSTOP .GT. 1000) THEN
          IFLAG=IFLAG+1
          UHAT=U1
          GO TO 100
      END IF
      IF(ABS(U2-UHAT) .GT. .0001) THEN
          UHAT=U2
          ALSTOP=ALSTOP+1
```

```
      GO TO 10
    END IF

100 COUNT=COMPAR(AMEAN,IBIRD,ITRUE,UHAT,COUNT)


    RETURN
    END
```

```
C            ******************************
C            * FUNCTION TO FIND THE MEDIAN *
C            ******************************
C
C...FINDS THE MEDIAN OF A SET OF NUMBERS
C
C
C


C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C   MUM      - HOLDS INDEX FOR SMALLEST NUMBER
C   NUMB     - NUMBER OF POINTS IN SET
C   SMAL(NM)- ORDER DATA FROM SMALLEST TO LARGEST
C   SMALL    - SMALLEST NUMBER
C   Y(M)     - INPUTED ARRAY TO FIND MEDIAN OF
C   Z(M)     - HOLDER ARRAY


      FUNCTION RMEDIN(Y,NUMB)
      REAL Y(10),SMALL,SMAL(10),Z(10)

      DO 5 I=1,NUMB
         Z(I)=Y(I)
    5 CONTINUE

C...COMPUTE MEDIAN OF OBSERVATIONS
         DO 25 NM = 1, NUMB

            SMALL=100000.0

            DO 30 M=1,NUMB

               IF (Z(M) .LE. SMALL) THEN
                  SMALL = Z(M)
                  MUM = M
                END IF

   30       CONTINUE

            SMAL(NM)=SMALL
            Z(MUM)=1000000.

   25    CONTINUE

         IF (NUMB/2. .NE. NUMB/2) THEN
               RMEDIN   = SMAL(IFIX(NUMB/2. +.5))
            ELSE
               RMEDIN  =(SMAL(NUMB/2)+SMAL((NUMB/2)+1))/2.
         END IF
      RETURN
      END
```

```
C          ***************************************************
C          * FUNCTION TO COMPARE ESTIMATED MEAN TO TRUE MEAN *
C          ***************************************************

C...FINDS MEAN WHICH THE ESTIMATE IS CLOSET TO.
C
C
C


C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C     COUNT   - CURRENT COUNT OF CORRECT ANSWERS
C     ITRUE   - TRUE VALUE OF CURRENT BIRDS MEAN
C     MEAN    - ARRAY CONTAINING ASSUMED MEANS
C     NBIRD   - INPUTED NUMBER OF BIRDS
C     UHAT    - CURRENT ESTIMATE OF THE MEAN

      FUNCTION COMPAR(MEAN,NBIRDS,ITRUE,UHAT,COUNT)
      REAL MEAN(10),UHAT,COUNT

      COMPAR=COUNT
      IF ( UHAT .LT. MEAN(1) .AND. MEAN(1) .EQ. ITRUE)THEN
             COMPAR=COUNT+1
             RETURN

         ELSE IF(UHAT.GT.MEAN(NBIRDS).AND.MEAN(NBIRDS).EQ.ITRUE)THEN
             COMPAR= COUNT + 1
             RETURN
      END IF
      IF (UHAT.GT. ITRUE-.5 .AND.UHAT .LT. ITRUE+.5) COMPAR=COUNT+1
      RETURN
      END
/*
//
```

APPENDIX C

SIMULATION CODE FOR THE TWO PARAMETER CASE

```
//T37A502B5  JOB (2341,9999),'FORTRAN A',CLASS=J
//*FORMAT PR,DDNAME=GO.FT06F001
//*FORMS=SEP1
//  EXEC FORTVCG
//FORT.SYSIN DD *
C...THIS PROGRAM SIMULATES THE DRAWING OF OBSERVATIONS ON A TWO PARAMETER
C   BIRD AND THEN ATTEMPTS TO IDENTIFY THE BIRD USING FOUR
C   ALGOITHMS.  THE INPUT IS MANUALLY BUT INTO THE INPUT SUBROUTINE.
C   THE PROGRAM IS THEN SUBMITTED TO BATCH AND THE RESULTS FOLLOW
C   THE END OF THE CODE.  CURRENTLY IT IS SET AS A CLASS J, WHICH
C   MEANS THE RESULTS WILL NOT BE AVAILABLE UNTIL THE NEXT DAY.

      COMMON X,U,NBIRDS,IBIRDS,NWATCH,NRUN,NTRIAL,ITRUE
      COMMON ASTDV1,ASTDV2,AVAR1,AVAR2,ARHO
      COMMON TEPS,TSTDV1,TSTDV2,TVAR1,TVAR2,TPRIOR
      DOUBLE PRECISION DSEED
      REAL X(2,10),U(2,10),EPS(5),ASTDV1(2,10),ASTDV2(2,10)
      REAL AVAR1(2,10),AVAR2(2,10),ARHO(10),TSTDV1(2,10),TSTDV(2,10)
      REAL TVAR1(2,10),TVAR2(2,10),CNT(7),REPS(7,20)
      REAL TPRIOR(10),REPMN(3,4,7),R(3)

C...INITIALIZE THE RANDOM NUMBER SEED

      CALL DATIME(I1,I2,I3,I4,I5,I6,I7,I8)
      DSEED=12342.D0*(1+I5+I6+I7+I8)
      CALL INPUT2(EPS)
      WRITE(6, 5) ARHO(1)
 5    FORMAT (' ASSUMED RHO =',F5.2)

C...THIS OUTER DO LOOP CYCLES THROUGH THE VALUES OF EPSILON FOR THE
C   DATA GENERATION

      R(1)=.5
      R(2)=0
      R(3)=-.5

      DO 350 M=1,4

C... SET THE TRUE EPSILON OR FLAG TO PICK A CAUCY ON LAST TRIP THROUGH

         IF ( M .LT. 3.5) THEN
              TEPS=EPS(M)
           ELSE
              TEPS=4.
         END IF

C...  THIS DO LOOP CYCLES THROUGH THE VALUES OF RHO

      DO 250 MNQ=1,3
              TRHO1=R(MNQ)
              TRHO2=R(MNQ)
       WRITE(6,*) R(MNQ),TRHO1,TRHO2

C...   THIS DO LOOP CYCLES THROUGH THE NUMBER OF OBSERVERS

      DO 200 NWATCH=2,5

C...  THIS DO LOOP CYCLES THROUGH THE RUNS
```

```
      DO 100 IRUN = 1,NRUN
         DO 10 N = 1,7
            CNT(N)=0
10       CONTINUE
C...     THIS DO LOOP CYCLES THROUGH THE INDIVIDUAL TRIALS
         DO 50 ISAM=1,NTRIAL

            CALL DRAW2(DSEED,TRHO1,TRHO2)
            CALL RMED(CNT(7),NWATCH,X,IBIRDS,U,ITRUE)
            CALL NORML2(CNT(1))
            CALL TMLE2(CNT(2),1.)
            CALL TMLE2(CNT(3),3.)
            CALL TMLE2(CNT(4),10.)
            CALL  EPMLE2(CNT(5),.1)
            CALL  EPMLE2(CNT(6),.25)
50       CONTINUE
C...      COMPUTE THE DIVIDE THE NUMBER OF CORRECT HIT BY NUMBER OF TRIAL
C         FOR EACH ALGORITHM
         DO 75 N=1,7
            REPS(N,IRUN)=CNT(N)/NTRIAL
75       CONTINUE
100   CONTINUE
C...  COMPUTE THE AVERAGE SUCCESS RATE FOR EACH ALGORITHM
      DO 125 N=1,7
         SUM=0
         DO 110 IRUN=1,NRUN
            SUM = SUM+REPS(N,IRUN)
110      CONTINUE
         REPMN(MNQ,NWATCH-1,N)=SUM/NRUN
125   CONTINUE
200   CONTINUE
250   CONTINUE
C...  RECORD THE RESULTS FOR EACH EPSILON

       WRITE(6,286)R(1),R(2),R(3)
286   FORMAT (17X,3(F3.1,9X))
       IF ( TEPS .LT. 3.5) THEN
           WRITE(6,297) EPS(M)
297     FORMAT(' EPS=',F3.2,3('   5/2 5/3 5/4 5/5'))
        ELSE
           WRITE(6,298)
298     FORMAT('CAUCHY   ',3('   5/2 5/3 5/4 5/5'))
       END IF
       WRITE(6,304) ((REPMN(MI,IN,7),IN=1,4),MI=1,3)
304   FORMAT (' MEDIAN    ',  3(4(F3.2,1X),2X))
       WRITE(6,305) ((REPMN(MI,IN,1),IN=1,4),MI=1,3)
305   FORMAT (' NORMMLE   ',3(4(F3.2,1X),2X))
       WRITE(6,306) ((REPMN(MI,IN,2),IN=1,4),MI=1,3)
```

```
306  FORMAT ( ' TMLE 1DF  ',3(4(F3.2,1X),2X))
      WRITE(6,307) ((REPMN(MI,IN,3),IN=1,4),MI=1,3)
307  FORMAT ( ' TMLE 3DF  ',3(4(F3.2,1X),2X))
      WRITE(6,308) ((REPMN(MI,IN,4),IN=1,4),MI=1,3)
308  FORMAT ( ' TMLE 10DF ',3(4(F3.2,1X),2X))
      WRITE(6,309) ((REPMN(MI,IN,5),IN=1,4),MI=1,3)
309  FORMAT ( ' EPMLE  .1 ',3(4(F3.2,1X),2X))
      WRITE(6,310) ((REPMN(MI,IN,6),IN=1,4),MI=1,3)
310  FORMAT ( ' EPMLE .25 ',3(4(F3.2,1X),2X))

350  CONTINUE

      STOP
      END
```

```
C                   ********************
C                   * INPUT SUBROUTINE *
C                   ********************


C...THIS SUBROUTINE IS THE LOCATION OF THE VARIABLE INPUTS


      SUBROUTINE INPUT2(EPS)

      COMMON X,U,NBIRDS,IBIRDS,NWATCH,NRUN,NTRIAL,ITRUE
      COMMON ASTDV1,ASTDV2,AVAR1,AVAR2,ARHO
      COMMON TEPS,TSTDV1,TSTDV2,TVAR1,TVAR2,TPRIOR
      REAL X(2,10),U(2,10),EPS(5),ASTDV1(2,10),ASTDV2(2,10)
      REAL AVAR1(2,10),AVAR2(2,10),ARHO(10),TSTDV1(2,10),TSTDV2(2,10)
      REAL TVAR1(2,10),TVAR2(2,10),TPRIOR(10)
C...ENTER THE NUMBER OF RUNS AND THE NUMBER OF TRIALS PER RUN
      NRUN=10
      NTRIAL=1000
C...ENTER THE NUMBER OF BIRDS
      NBIRDS=5
C...READ THE 1ST AND 2ND PARAMETER MEANS FOR THE JTH BIRD
      U(1,1)= 1.
      U(2,1)= 1.

      U(1,2)= 2.
      U(2,2)= 2.

      U(1,3)= 3.
      U(2,3)= 3.

      U(1,4)= 4.
      U(2,4)= 4.

      U(1,5)= 5.
      U(2,5)= 5.

C...ENTER THE PRIOR DISTRIBUTIONS
      TPRIOR(1)= .0
      TPRIOR(2)= .0
      TPRIOR(3)= .0
      TPRIOR(4)= .0
      TPRIOR(5)= 1.

C...ENTER THE ASSUMED NUMBER OF BIRDS
      IBIRDS=NBIRDS

C...READ THE TRUE VALUE  OF THE SCALES FOR 1ST AND 2ND
          TSTDV1(1,1)=.3
          TSTDV1(2,1)=.7
          TSTDV2(1,1)=3
          TSTDV2(2,1)=7

          TSTDV1(1,2)=.3
          TSTDV1(2,2)=.7
          TSTDV2(1,2)=3
          TSTDV2(2,2)=7

          TSTDV1(1,3)=.3
          TSTDV1(2,3)=.7
          TSTDV2(1,3)=3
          TSTDV2(2,3)=7

          TSTDV1(1,4)=.3
          TSTDV1(2,4)=.7
          TSTDV2(1,4)=3
```

```
      TSTDV2(2,4)=7

      TSTDV1(1,5)=.3
      TSTDV1(2,5)=.7
      TSTDV2(1,5)=3
      TSTDV2(2,5)=7

C...READ THE ASSUMED VALUES FOR THE ABOVE
      ARHO(1)= .0
      ASTDV1(1,1)=.5
      ASTDV1(2,1)=.5
      ASTDV2(1,1)=5
      ASTDV2(2,1)=5

      ARHO(2)= .0
      ASTDV1(1,2)=.5
      ASTDV1(2,2)=.5
      ASTDV2(1,2)=5
      ASTDV2(2,2)=5

      ARHO(3)= .0
      ASTDV1(1,3)=.5
      ASTDV1(2,3)=.5
      ASTDV2(1,3)=5
      ASTDV2(2,3)=5

      ARHO(4)= .0
      ASTDV1(1,4)=.5
      ASTDV1(2,4)=.5
      ASTDV2(1,4)=5
      ASTDV2(2,4)=5

      ARHO(5)= .0
      ASTDV1(1,5)=.5
      ASTDV1(2,5)=.5
      ASTDV2(1,5)=5
      ASTDV2(2,5)=5

C...ENTER THE VALUES FOR EPSILON
      EPS(1)=0
      EPS(2)=.1
      EPS(3)=.25
   RETURN
   END
```

```
C          ***************************************************
C          * SUBROUTINE TO GENERATE THE RANDOM NUMBERS *
C          ***************************************************

C...THIS SUBROUTINE GENERATES THE RANDOM NUMBERS ACCORDING TO A
C   BIVARIATE MIXED NORMAL DISTRIBUTION OR BIVARIATE CAUCHY

      SUBROUTINE DRAW2(DSEED,TRHO1,THRO2)

      COMMON X,U,NBIRDS,IBIRDS,NWATCH,NRUN,NTRIAL,ITRUE
      COMMON ASTDV1,ASTDV2,AVAR1,AVAR2,ARHO
      COMMON TEPS,TSTDV1,TSTDV2,TVAR1,TVAR2,TPRIOR
      REAL X(2,10),U(2,10),EPS(5),ASTDV1(2,10),ASTDV2(2,10)
      REAL AVAR1(2,10),AVAR2(2,10),ARHO(10),TSTDV1(2,10),TSTDV2(2,10)
      REAL TVAR1(2,10),TVAR2(2,10),TPRIOR(10),WK(2)
      DOUBLE PRECISION DSEED

      CUMPRO=0
      RANDOM = GGUBFS(DSEED)

C...RANDOMLY PICKS A RADAR TO SING BASED ON THE INPUT PRIOR
C   PROBABILITIES

      DO 25 J=1,NBIRDS

         CUMPRO=CUMPRO+TPRIOR(J)

         IF ( RANDOM .LT. CUMPRO ) THEN
            ZMEAN1= U(1,J)
            ZMEAN2=U(2,J)
            ITRUE=J
            GO TO 30
         END IF
   25 CONTINUE

   30 IF ( TEPS .GT. 2 ) THEN

C...THIS COMPUTES THE OBSERVATIONS BASED ON AN ALGORITHM IN LAW AND
C   KELTON FOR CAUCHY DISTRIBUTED ERROR

      DO 35 I=1,NWATCH

C...    COMPUTES ERROR BASED ON T DIST FROM THE IMSL LIBRARY

                  CALL GGNML(DSEED,1,RAN1)
                  CALL GGAMR(DSEED,.5,1,WK,RAN3)
                  IF(RAN3 .LT. .00000001)      RAN3 = .00000001
                  RAN1=RAN1/SQRT((RAN3+RAN3))

C...    COMPUTES ERROR BASED ON T DIST FROM THE IMSL LIBRARY

                  CALL GGNML(DSEED,1,RAN2)
                  RAN2=RAN2/SQRT((RAN3+RAN3))

C...       AFTER GENERATING THE RANDOM NUMBERS WE ADJUST THEM TO FIT

            X(1,I)=(RAN1*TSTDV1(1,I)) + ZMEAN1
            RNEW=RAN2*TSTDV1(2,I)*((1-(TRHO1**2))**.5)
            X(2,I)=ZMEAN2 + (TRHO1*TSTDV1(2,I)*RAN1)
            X(2,I)=X(2,I) + RNEW

   35 CONTINUE
       ELSE

C...THIS COMPUTES THE OBSERVATIONS BASED ON AN ALGORITHM IN LAW AND
C   KELTON
```

```
      DO 50 I=1,NWATCH
            RANDOM=GGUBFS(DSEED)
            CALL GGNML(DSEED,1,RAN2)
            CALL GGNML(DSEED,1,RAN1)
C...        AFTER GENERATING THE RANDOM NUMBERS WE ADJUST THEM TO FIT
          IF(RANDOM .GT. TEPS) THEN
            X(1,I)=(RAN1*TSTDV1(1,I)) + ZMEAN1
            RNEW=RAN2*TSTDV1(2,I)*((1-(TRHO1**2))**.5)
            X(2,I)=ZMEAN2 + (TRHO1*TSTDV1(2,I)*RAN1)
            X(2,I)=X(2,I) + RNEW
           ELSE
            X(1,I)=(RAN1*TSTDV2(1,I)) + ZMEAN1
            RNEW=RAN2*TSTDV2(2,I)*((1-(TRHO2**2))**.5)
            X(2,I)=ZMEAN2 + (TRHO2*TSTDV2(2,I)*RAN1)
            X(2,I)=X(2,I) + RNEW
          END IF
   50  CONTINUE
        END IF
          RETURN
          END
```

```
C           *********************************
C           * SUBROUTINE TO COMPUTE BVN MLE *
C           *********************************

C...THIS SUBROUTINE IDENTIFIES THE BIRD BY THE BIVARIATE NORMAL MLE
C   ALGORITHM DESCRIBED IN CHAPTER 3

      SUBROUTINE  NORML2(COUNT)

      COMMON X,U,NBIRDS,IBIRDS,NWATCH,NRUN,NTRIAL,ITRUE
      COMMON ASTDV1,ASTDV2,AVAR1,AVAR2,ARHO
      COMMON TEPS,TSTDV1,TSTDV2,TVAR1,TVAR2,TPRIOR
      DOUBLE PRECISION DSEED
      REAL X(2,10),U(2,10),EPS(5),ASTDV1(2,10),ASTDV2(2,10)
      REAL AVAR1(2,10),AVAR2(2,10),ARHO(10),TSTDV1(2,10),TSTDV2(2,10)
      REAL TVAR1(2,10),TVAR2(2,10),TPRIOR(10)

      RMAX=-10000000
      DO 100 J=1,IBIRDS

         SUM=0

C...     COMPUTE THE MLE FOR EACH RADAR

         DO 50 I=1,NWATCH

            X1=(X(1,I)-U(1,J))/ASTDV1(1,I)
            X2=(X(2,I)-U(2,J))/ASTDV1(2,I)
            Y=(2*(1-(ARHO(I)**2)))
            SUM=SUM - (((X1**2) - (2*ARHO(I)*X1*X2) + (X2**2))/Y)
            Y1=(1-(ARHO(I)**2))**.5
            SUM=SUM-LOG(2.506628*ASTDV1(1,I)*ASTDV1(2,I)*Y1)

  50     CONTINUE

C...     COMPARISION TO WEED OUT THE LARGEST VALUE

         IF ( SUM .GT. RMAX) THEN
            RMAX=SUM
            MAX=J
         END IF

 100     CONTINUE

C...     COMPARE PICKED VALUES TO TRUE VALUE

         IF ( MAX .EQ. ITRUE) COUNT = COUNT+1

         RETURN
         END
```

```
C           **********************************
C           * SUBROUTINE TO COMPUTE THE T MLE *
C           **********************************


C...THIS SUBROUTINE COMPUTES THE T MLE AND UPDATES THE COUNT
      SUBROUTINE TMLE2(COUNT,DF)

      COMMON X,U,NBIRDS,IBIRDS,NWATCH,NRUN,NTRIAL,ITRUE
      COMMON ASTDV1,ASTDV2,AVAR1,AVAR2,ARHO
      COMMON TEPS,TSTDV1,TSTDV2,TVAR1,TVAR2,TPRIOR
      REAL X(2,10),U(2,10),EPS(5),ASTDV1(2,10),ASTDV2(2,10)
      REAL AVAR1(2,10),AVAR2(2,10),ARHO(10),TSTDV1(2,10),TSTDV2(2,10)
      REAL TVAR1(2,10),TVAR2(2,10),TPRIOR(10)

      RMAX=-100000
      DO 100 J=1,IBIRDS
         SUM=0

         DO 50 I=1,NWATCH
            RH=1-ARHO(I)**2
            X1=(X(1,I)-U(1,J))/ASTDV1(1,I)
            X2=(X(2,I)-U(2,J))/ASTDV1(2,I)
            Y1=1 + (((X1**2) - (2*ARHO(I)*X1*X2) + (X2**2))/(DF*RH))
            T1= 1/((ASTDV1(1,I)**2)*(ASTDV1(2,I)**2)*RH)
            T1=T1+ (2*ARHO(I)/(ASTDV1(1,I)*ASTDV1(2,I)*RH))
            SUM=SUM - ((DF+2)/2)*LOG(Y1) + LOG(T1)
  50     CONTINUE

C...     WEED OUT THE BIGGEST VALUE

         IF(SUM .GT. RMAX) THEN
            RMAX=SUM
            MAX=J
         END IF
 100  CONTINUE

C...  COMPARE OUR CHOICE TO THE TRUE VALUE

      IF(MAX .EQ. ITRUE) COUNT = COUNT + 1

      RETURN
      END
```

```
C       ******************************************
C       * SUBROUTINE TO COMPUTE THE MIXED NORMAL MLE *
C       ******************************************

C..THIS SUBROUTINE COMPUTES THE MIXED NORMAL MLE ALGORITHM

      SUBROUTINE  EPMLE2(COUNT,AEPS)
      COMMON X,U,NBIRDS,IBIRDS,NWATCH,NRUN,NTRIAL,ITRUE
      COMMON ASTDV1,ASTDV2,AVAR1,AVAR2,ARHO
      COMMON TEPS,TSTDV1,TSTDV2,TVAR1,TVAR2,TPRIOR
      REAL X(2,10),U(2,10),EPS(5),ASTDV1(2,10),ASTDV2(2,10)
      REAL AVAR1(2,10),AVAR2(2,10),ARHO(10),TSTDV1(2,10),TSTDV2(2,10)
      REAL TVAR1(2,10),TVAR2(2,10),TPRIOR(10)
      DOUBLE PRECISION SUM,AEPS,RMAX

      RMAX=-100000000.0

      DO 100 J = 1,IBIRDS

         SUM=0.D0

C...     COMPUTE THE ESTIMATOR FOR EACH BIRD

         DO 50 I=1,NWATCH

            X1=(X(1,I)-U(1,J))/ASTDV1(1,I)
            X2=(X(2,I)-U(2,J))/ASTDV1(2,I)
            X3=(X(1,I)-U(1,J))/ASTDV2(1,I)
            X4=(X(2,I)-U(2,J))/ASTDV2(2,I)

            Y= 2.0*(1-(ARHO(I)**2))

            C1=6.2832*ASTDV1(1,I)*ASTDV1(2,I)*((1-ARHO(I)**2)**.5)
            ET1=((X1**2)-(2*ARHO(I)*X1*X2)+(X2**2))/Y
            PART1=ET1+LOG(C1)
            IF ( PART1 .GT. 174) PART1=174.

            C2=6.2832*ASTDV2(1,I)*ASTDV2(2,I)*((1-ARHO(I)**2)**.5)
            ET2=((X3**2)-(2*ARHO(I)*X3*X4)+(X4**2))/Y
            PART2=ET2+LOG(C2)
            IF ( PART2 .GT. 174) PART2=174.

            SUM=SUM+LOG(((1.D0-AEPS)/EXP(PART1)) + (AEPS/EXP(PART2)))

  50     CONTINUE

C...     FIND THE LARGEST VALUE

         IF( SUM .GT. RMAX) THEN
            RMAX=SUM
            MAX=J
         END IF

 100  CONTINUE

C...  COMPARE THE SELECTED RADAR TO THE TRUE RADAR

      IF(MAX .EQ. ITRUE) COUNT=COUNT+1
      RETURN
      END
```

```
C         *******************************************
C         * SUBROUTINE TO FIND THE MEDIAN BASED METHOD *
C         *******************************************

C...THIS SUBROUTINE FINDS THE MEDIAN OF THE OBSERVATIONS FOR EACH
C    PARAMETER AND THEN PICKS THE POINT THAT MINIMIZES THE
C    EUCLIDEAN DISTANCE

      SUBROUTINE RMED(COUNT,NWATCH,X,IBIRDS,U,ITRUE)
      REAL X(2,10),X1(10),X2(10),U(2,10),MED1,MED2
      DO 25 N=1,IBIRDS
         X1(N)=X(1,N)
         X2(N)=X(2,N)
   25 CONTINUE

C...     FIND THE MEDIAN OF EACH PARAMETER

       MED1=RMEDIN(X1,NWATCH)
       MED2=RMEDIN(X2,NWATCH)
       RMAX=10000

C...    FIND THE POINT THAT IS CLOSEST TO THE SELECTED POINT

       DO 50 J=1,IBIRDS
          SUM=SQRT((MED1-U(1,J))**2 + ( MED2-U(2,J))**2)
          IF ( SUM .LT. RMAX ) THEN
             RMAX = SUM
             MAX = J
          END IF
 50    CONTINUE
       IF ( MAX .EQ. ITRUE) COUNT = COUNT + 1
       RETURN
       END
```

```
C            *******************************
C            * FUNCTION TO FIND THE MEDIAN *
C            *******************************

C...FINDS THE MEDIAN OF A SET OF NUMBERS
C
C
C


C   DEFINITIONS OF LOCAL VARIABLES
C   ------------------------------

C   MUM      - HOLDS INDEX FOR SMALLEST NUMBER
C   NUMB     - NUMBER OF POINTS IN SET
C   SMAL(NM)- ORDER DATA FROM SMALLEST TO LARGEST
C   SMALL    - SMALLEST NUMBER
C   Y(M)     - INPUTED ARRAY TO FIND MEDIAN OF
C   Z(M)     - HOLDER ARRAY


      FUNCTION RMEDIN(Y,NUMB)
      REAL Y(10),SMALL,SMAL(10),Z(10)

      DO 5 I=1,NUMB
          Z(I)=Y(I)
    5 CONTINUE

C...COMPUTE MEDIAN OF OBSERVATIONS

          DO 25 NM = 1, NUMB

              SMALL=100000.0

              DO 30 M=1,NUMB

                  IF (Z(M) .LE. SMALL) THEN
                      SMALL = Z(M)
                      MUM = M
                   END IF

   30           CONTINUE

              SMAL(NM)=SMALL
              Z(MUM)=1000000.

   25     CONTINUE

          IF (NUMB/2. .NE. NUMB/2) THEN
                  RMEDIN   = SMAL(IFIX(NUMB/2. +.5))
              ELSE
                  RMEDIN  =(SMAL(NUMB/2)+SMAL((NUMB/2)+1))/2.
          END IF
      RETURN
      END
/*
//
```

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